Watershed Health

October 2024

Le Sueur River Watershed Stressor Identification Update

A study of local stressors limiting the biotic communities in the Le Sueur River Watershed.

MINNESOTA POLLUTION CONTROL AGENCY

CLEAN WATER LAND & LEGACY AMENDMENT

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Key terms and abbreviations

BMP	best management practice
CADDIS	Causal Analysis/Diagnosis Decision Information System
CI	confidence interval
CL	confidence limits
DELT	deformities, eroded fins, lesions, and tumors
DO	dissolved oxygen
DNR	Minnesota Department of Natural Resources
EPA	Environmental Protection Agency

EPT	Ephemeroptera, Plecoptera, and Trichoptera
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
IWM	Intensive Watershed Monitoring
MDA	Minnesota Department of Agriculture
mg/L	milligrams per Liter
MPCA	Minnesota Pollution Control Agency
MSHA	MPCA Stream Habitat Assessment
N	nitrate
SID	stressor identification
SOE	strength of evidence
TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
TSVS	total suspended volatile solids
USGS	United States Geological Survey
WID	water body identification number
WPLMN	Watershed Pollutant Monitoring Network
WRAPS	watershed restoration and protection strategies

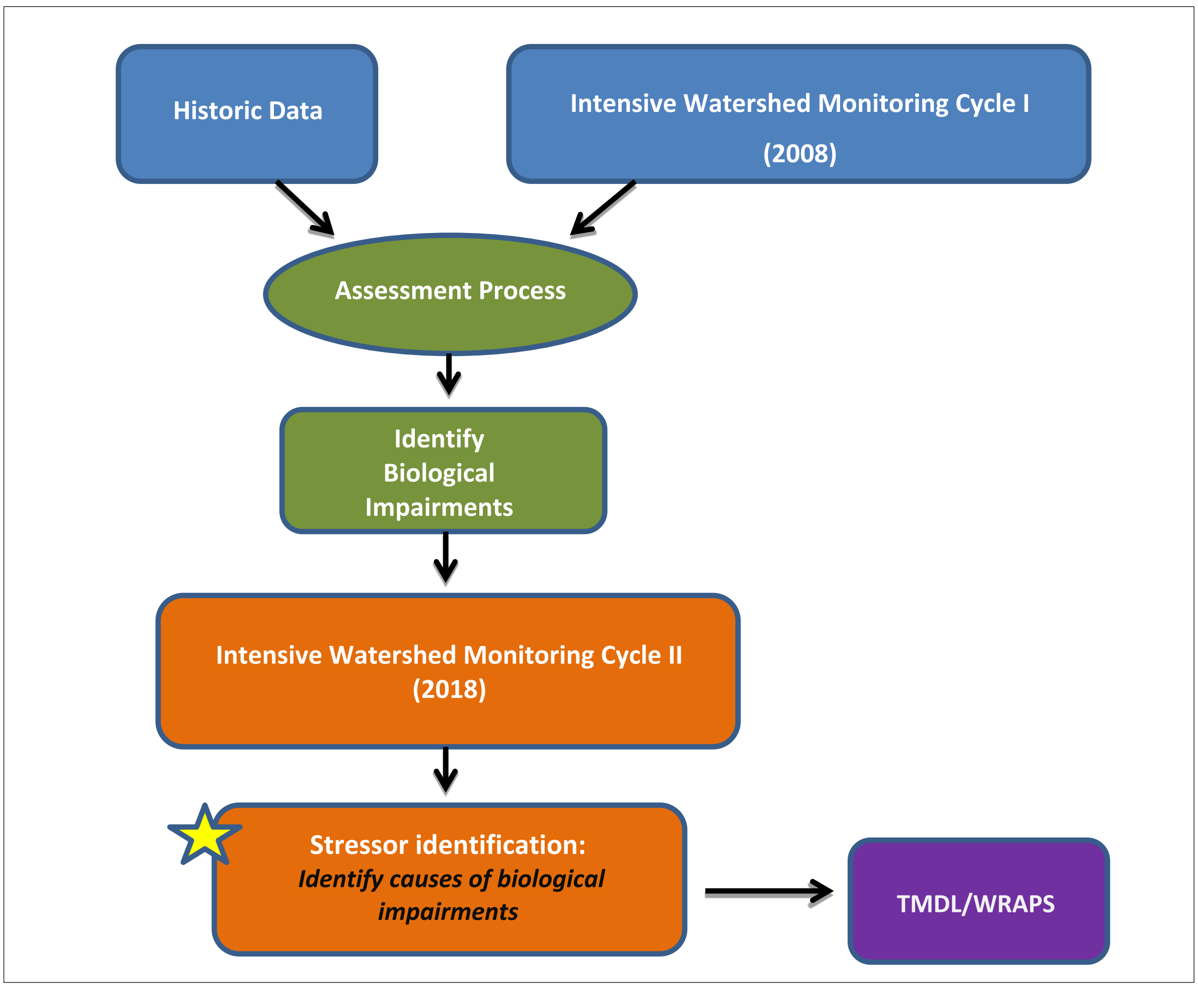
1. Introduction

Monitoring and assessment

Water quality and biological monitoring in the Le Sueur Watershed has been ongoing. As part of the Minnesota Pollution Control Agency's (MPCA's) Intensive Watershed Monitoring (IWM) approach, monitoring activities increased in rigor and intensity during the years of 2018 through 2022 and focused more on biological monitoring (fish and macroinvertebrates) as a means of assessing stream health. The data collected during this period, as well as historic data obtained prior to 2018, were used to identify stream reaches that were not supporting healthy fish and macroinvertebrate assemblages (Figure 1).

Once a biological impairment is discovered, the next step is to identify the source(s) of stress on the biological community. A stressor identification (SID) analysis is a step-by-step approach for identifying probable causes of impairment in a particular system. Completion of the SID process does not result in a finished total maximum daily load (TMDL) study. The product of the SID process is the identification of the stressor(s) for which the TMDL may be developed. In other words, the SID process may help investigators identify excess fine sediment as the cause of biological impairment, but a separate effort is then required to determine the TMDL, and implementation goals needed to restore the impaired condition.

Figure 1. Process map of IWM, assessment, SID and TMDL processes.

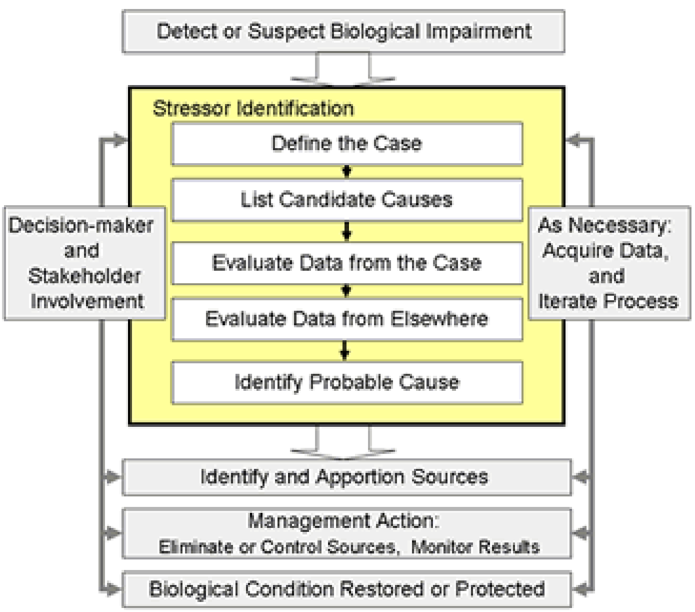


Stressor identification process

The MPCA follows the U.S. Environmental Protection Agency's (EPA's) process of identifying stressors that cause biological impairment, which has been used to develop the MPCA's guidance to SID (Cormier et al. 2000; MPCA 2008). The EPA has also developed an updated, interactive web-based tool, the Causal Analysis/Diagnosis Decision Information System (CADDIS; EPA 2010). This system provides an enormous amount of information designed to guide and assist investigators through the process of SID. Additional information on the SID process using CADDIS can be found here: http://www.epa.gov/caddis/.

SID is a key component of the major watershed restoration and protection projects being carried out under Minnesota's Clean Water Legacy Act (ROS 2022). SID draws upon a broad variety of disciplines and applications, such as aquatic ecology, geology, geomorphology, chemistry, land use analysis, and toxicology. A conceptual model showing the steps in the SID process is shown in Figure 2. Through a review of available data, stressor scenarios are developed that aim to characterize the biological impairment, the cause, and the sources/pathways of the various stressors.

Figure 2. Conceptual model of SID process (Cormier et al. 2000).



Strength of evidence (SOE) analysis is used to evaluate the data for candidate causes of stress to biological communities. The relationship between stressor and biological response are evaluated by considering the degree to which the available evidence supports or weakens the case for a candidate cause. Typically, much of the information used in the SOE analysis is from the study watershed (i.e., data from the case). However, evidence from other case studies and the scientific literature is also used in the SID process (i.e., data from elsewhere).

The existence of multiple lines of evidence that support or weaken the case for a candidate cause generally increases confidence in the decision for a candidate cause. Additionally, confidence in the results depends on the quantity and quality of data available to the SID process. In some cases, additional data collection may be necessary to accurately identify the stressor(s) causing impairment. Additional detail on the various types of evidence and interpretation of findings can be found here: EPA CADDIS.

Common stream stressors

The five major elements of a healthy stream system as defined by the Minnesota Department of Natural Resources (DNR) are stream connections, hydrology, stream channel assessment, water chemistry and stream biology. If one or more of the components are unbalanced, the stream ecosystem may fail to function properly and is listed as an impaired water body. Table 1 lists the common stream stressors to biology relative to each of the major stream health categories.

Table 1. Common streams stressors to biology (i.e., fish and macroinvertebrates).

Stream health	Stressor(s) and examples	Link to biology
Stream connections	**Loss of connectivity** • Dams and culverts • Lack of wooded riparian cover • Lack of naturally connected habitats/ causing fragmented habitats	Fish and macroinvertebrates cannot freely move throughout system or complete their lifecycle. Loss of refuge areas (lakes and wetlands) during times of lost stream connectivity damage fish communities.
Hydrology	**Altered hydrology** **Loss of habitat due to channelization** **Elevated levels of total suspended solids (TSS)** • Channelization • Peak discharge (flashy) • Transport of chemicals	Unstable flow regime within the stream can cause a lack of habitat, unstable stream banks, filling of pools and riffle habitat, and affect the fate and transport of chemicals. Stream temperatures also become elevated due to lack of shade from compromised riparian area.
Stream channel assessment	**Loss of habitat due to stream modifications** **Loss of dimension/pattern/profile** • Bank erosion from instability • Loss of riffles due to accumulation of fine sediment • Increased turbidity and or TSS	Habitat is degraded due to excess sediment moving through system. There is a loss of clean rock substrate from embeddedness of fine material and a loss of intolerant species. Habitat diversity becomes less abundant.
Water chemistry	**Low dissolved oxygen (DO) concentrations** **Elevated levels of nutrients** • Increased nutrients from human influence • Widely variable DO levels during the daily cycle • Increased algal and or periphyton growth in stream • Increased nonpoint pollution from urban and agricultural practices • Increased point source pollution from urban treatment facilities	There is a loss of intolerant species and a loss of diversity of species, which tends to favor species that can breathe air or survive under low DO conditions. Biology tends to be dominated by a few tolerant species.
Stream biology	Fish and macroinvertebrate communities are affected by all the above listed stressors	If one or more of the above stressors are affecting the fish and macroinvertebrate community, the index of biotic integrity (IBI) scores will not meet expectations and the stream will be listed as impaired.

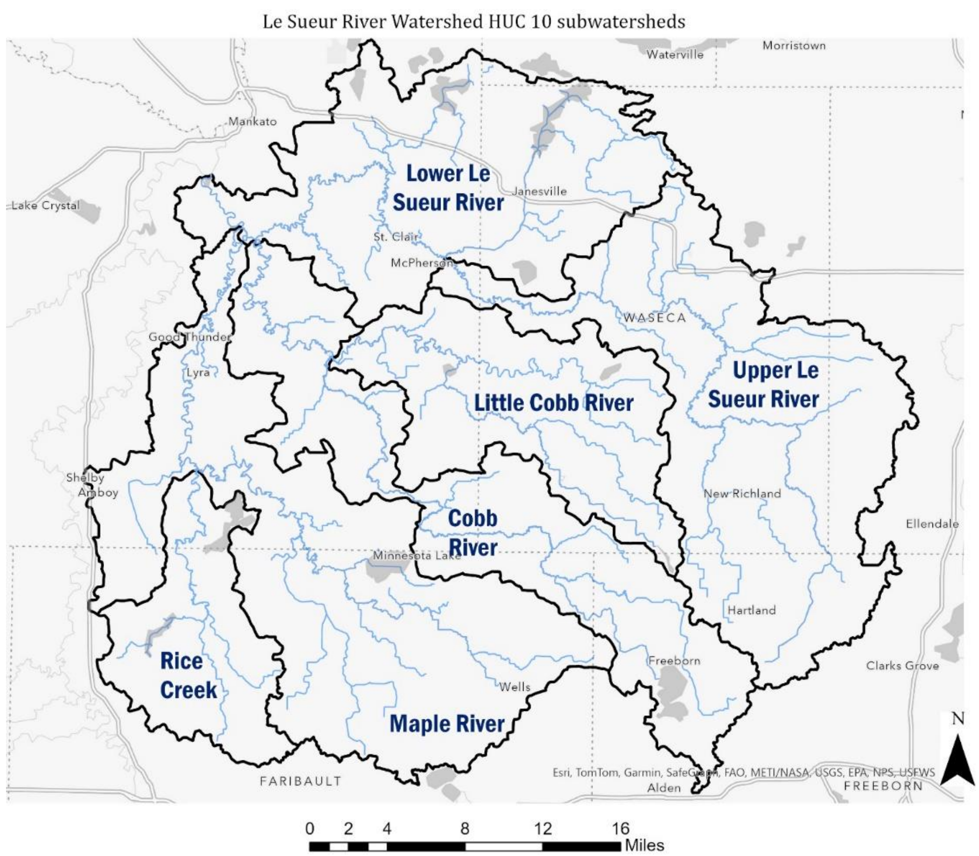
Report Format

This is the second time the Le Sueur River Watershed has undergone this level of assessment for biology. The first assessment period occurred in 2008 and is referenced as Cycle 1. Biological impairments were investigated and incorporated into the Le Sueur River Watershed Biotic Stressor Identification Report (MPCA 2014). Cycle 2 monitoring and assessment began in 2018, which allowed for re-evaluation of the Le Sueur River Watershed and to determine if the status of biological impaired streams had changed. For overall findings see the Watershed Assessment Trends and Update for the Le Sueur River Watershed (MPCA 2021). Although there was significant overlap in site locations between the two cycles, not all the sites sampled in Cycle 1 were re-sampled in Cycle 2 (Figure 5). This biotic stressor update report will primarily focus on locations that were monitored in Cycle 2.

Several locations that were sampled for biology during Cycle 1 were on streams that had been modified by way of channelizing. At the time of Cycle 1 assessments, impairment thresholds for modified streams (such as channelizing) had not yet been developed resulting in deferrals. Assessment thresholds for impairments were established by the outset of Cycle 2, see Tiered Aquatic Life development (MPCA 2018). However, some Cycle 1 sites were not reassessed in Cycle 2, leaving limitations in the expired data. Many of these locations are accounted for throughout the report, yet there may not be stressors identified. Priority locations where extra data was collected were determined using public and collaborative multi-agency input.

This SID report format will first summarize candidate causes of stress to the biological communities at the 8-digit hydrologic unit code (HUC) scale. The analysis of sample sites will be looked at and discussed by water body identification number (WID) at the 10-digit HUC scale, shown in Figure 3 below.

Figure 3. Le Sueur River Watershed Subwatersheds at the HUC-10 scale.

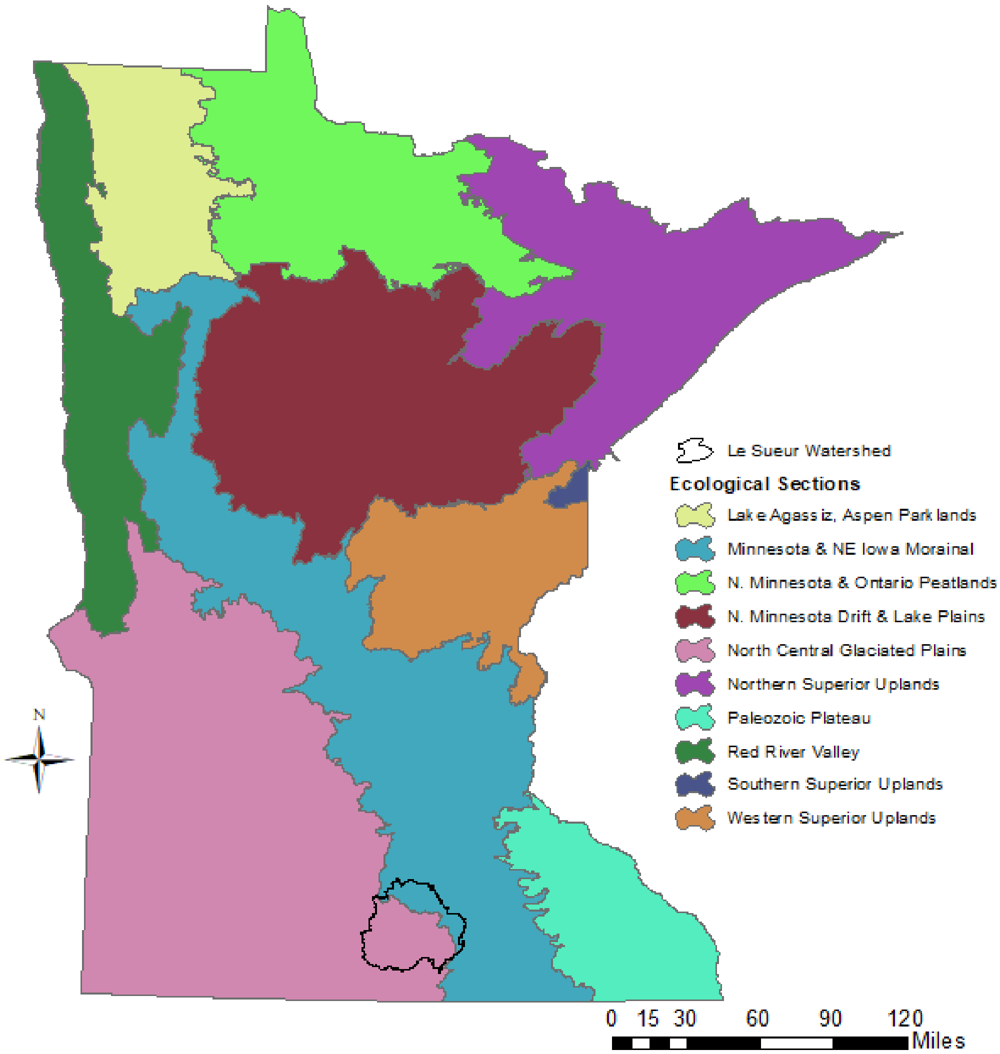


2. Overview of the Le Sueur River Watershed

Background

The Le Sueur River Watershed (07020011 HUC-8) is in the south-central portion of Minnesota. The 1,500 square mile watershed primarily falls into the counties of Blue Earth, Waseca, and Faribault. Freeborn and Steele Counties are limited to the headwaters portion of the watershed. The Le Sueur River Watershed is mainly within the North Central Glaciated Plains and the Minnesota and Northeast Iowa morainal region (Figure 4).

Figure 4. Map of ecological zones within the Le Sueur River Watershed.



Following European settlement, most of the Le Sueur River Watershed landscape was converted from prairie to agricultural fields. These changes to the land resulted in loss of water retention areas (wetlands) and modifications to the stream systems within the watershed. Historical and current land use will be discussed in further detail in Section 3.1.8 Altered Hydrology portion of this report.

Past Findings and Recommendations (Cycle 1) SID

The Cycle 1 Le Sueur River Watershed SID Report was published in May of 2014. The following several paragraphs summarize the main findings contained within the report. In the Le Sueur River Watershed, lack of habitat and altered hydrology were stressors throughout many of the stream and river reaches that are impaired for biology. Elevated turbidity and TSS were common as well. Elevated levels of phosphorus and nitrate were stressors in many of the larger rivers, but additional data should be collected in some of the smaller systems. Low DO was problematic in the Little Cobb River and in Rice Creek. Both systems appear to be experiencing low DO under low flow conditions. Physical barriers exist on County Ditch (CD) 6 that does not allow for the migration of fish species through Lake Elysian to Iosco Creek. Table 2 shows the stressors to the biology by WID determined during Cycle 1.

Table 2. Cycle 1 SID findings (MPCA 2014).

			Dissolved Oxygen	Eutrophication	Nitrate	Turbidity/ TSS	Habitat	Altered Hydrology	Connectivity
07020011-501	Le Sueur River	Fish	N	Y	Y	Y	Y	Y	N
07020011-504	Little Cobb River	Fish	Y	Y	Y	Y	Y	Y	N
07020011-507	Le Sueur River	Fish	N	Y	Y	Y	Y	Y	N
07020011-510	UnNmed Creek	Invertebrates	IF	IF	IF	IF	Y	Y	N
07020011-522	County Ditch 6	Invertebrates	N	IF	N	IF	Y	Y	Y
07020011-531	Rice Creek	Fish & Invertebrates	Y	Y	Y	Y	Y	Y	N
07020011-534	Maple River	Invertebrates	N	Y	Y	Y	Y	Y	N
07020011-535	Maple River	Fish & Invertebrates	N	IF	IF	Y	Y	Y	N
07020011-556	Cobb River	Fish & Invertebrates	N	Y	Y	Y	Y	Y	N
07020011-558	County Ditch 12	Fish & Invertebrates	IF	IF	IF	N	Y	Y	N
07020011-568	Cobb River	Fish & Invertebrates	N	IF	IF	Y	Y	Y	N
07020011-573	Little Le Sueur River	Fish	IF	IF	IF	N	Y	Y	N
07020011-576	Iosco Creek	Fish & Invertebrates	IF	IF	IF	N	Y	Y	N
07020011-608	County Ditch 19	Fish & Invertebrates	IF	IF	IF	N	Y	Y	N
07020011-609	County Ditch 15-2	Fish & Invertebrates	IF	IF	IF	IF	Y	Y	N
07020011-619	Le Sueur River	Fish	N	IF	IF	Y	N	Y	N

***N is not a stressor; Y is a stressor, IF is insufficient as a stressor.**

It was recommended that in the future additional data collection efforts should be focused on upstream reaches where there is limited data, and many indicators of issues exist. In addition, monitoring at the lake outlets would also provide needed information to assist source information of elevated nutrient concentrations and loads. Additional diurnal DO data would refine the relationships where there were low DO issues, and early morning DO should be collected in many of the small tributaries to the Le Sueur River under a variety of flow conditions.

Reductions of sensitive species and abundance of tolerant species is associated with excessive nutrients such as nitrate and phosphorus. These nutrients are vital to plant growth but can have significant consequences to biotic communities when present in excess.

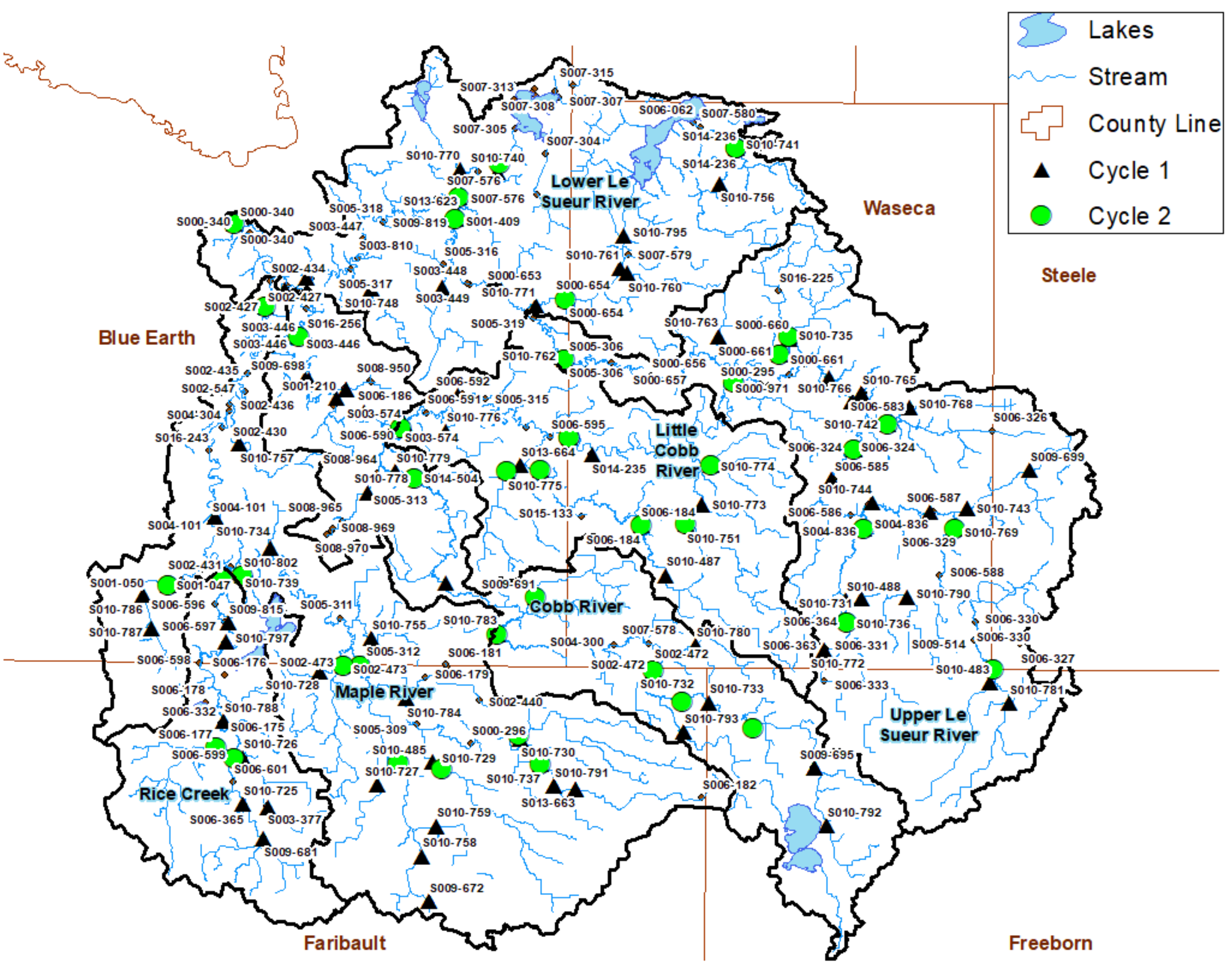
Much of the Le Sueur River Watershed would benefit from increasing water detention and infiltration to maintain a biologically adequate baseflow and reduce the export of water from the watershed. Additionally, connections to existing floodplains should be maintained and measures should be taken to improve stream stability to achieve balance in flows and sediment transport.

Lack of habitat should be dealt with on a small-scale basis as it is variable throughout the watershed. In general, much of the lack of habitat was due to lack of stream stability, lack of riparian vegetation/buffers, and excess embeddedness

Assessment for biological impairments for Cycle 2

The Le Sueur River Watershed was one of the first watersheds within the state of Minnesota to implement the watershed scale approach to monitoring and developing technical reports to assist in watershed restoration and protection strategies (WRAPS). It is important to note that during Cycle 1 of the Le Sueur's SID investigation, aquatic life standards for modified streams were not yet developed. For this reason, many of the Le Sueur River Watershed headwater sites were not able to be fully evaluated and often were deferred for re-evaluation in Cycle 2. The original SID report (MPCA 2014) only assessed biological impairments in streams that had natural habitat features, and not physically modified or altered within that direct area. Throughout this SID updated report, there will be a section dedicated to identifying those sites under each HUC-10 subsection. It is important to recognize most of these locations will not have SID assessment or were found to be "nonassessable" because of outdated data if there was not a Cycle 2 biological sample done. Figure 5 below highlights the locations where biological sampling occurred in Cycle 1 and 2. Note, that Cycle 2 locations were often placed at different locations compared to the original sample sites.

Figure 5. Map of monitoring stations in the Le Sueur River Watershed.



The approach used to identify biological impairments includes assessment of fish and aquatic macroinvertebrate communities, in relation to their habitat conditions, and stream type. The resulting information is used to develop a quantitative measurement known as the index of biologic integrity (IBI). The IBI scores can then be compared to a range of thresholds. Community metrics are attached as an Appendix item or can be requested for more detailed analysis.

The fish and macroinvertebrates within each WID were compared to a regionally developed threshold and confidence interval (CI) and utilized a weight of evidence approach. The water quality standards call for the maintenance of a healthy community of aquatic life. IBI scores provide a measurement tool to assess the health of the aquatic communities. IBI scores higher than the impairment threshold indicate that the stream reach supports aquatic life. Conversely, scores below the impairment threshold indicate that the stream reach does not support aquatic life (Figure 6 and Figure 7). Confidence limits (CL) around the impairment threshold help to ascertain where additional information may be considered to help inform the impairment decision. When IBI scores fall within the CI, interpretation and assessment of the water body condition involves consideration of potential stressors, and draws upon additional information regarding water chemistry, physical habitat, and land use.

In addition to streams that are found to have biological impairments, this update will also highlight some of the streams that are found to be fully supporting the fish and macroinvertebrate communities. These are especially important to highlight, as many impaired communities showed consistency in their scores in both Cycle 1 and Cycle 2. Streams that had previous impaired communities that now are in full support were often noted in having a significant number of BMPs implemented. Unfortunately, identifying the most successful practices that resulted in stream improvement is out of the scope of this report.

Figure 6. Current fish impairment status by WID within the Le Sueur River Watershed

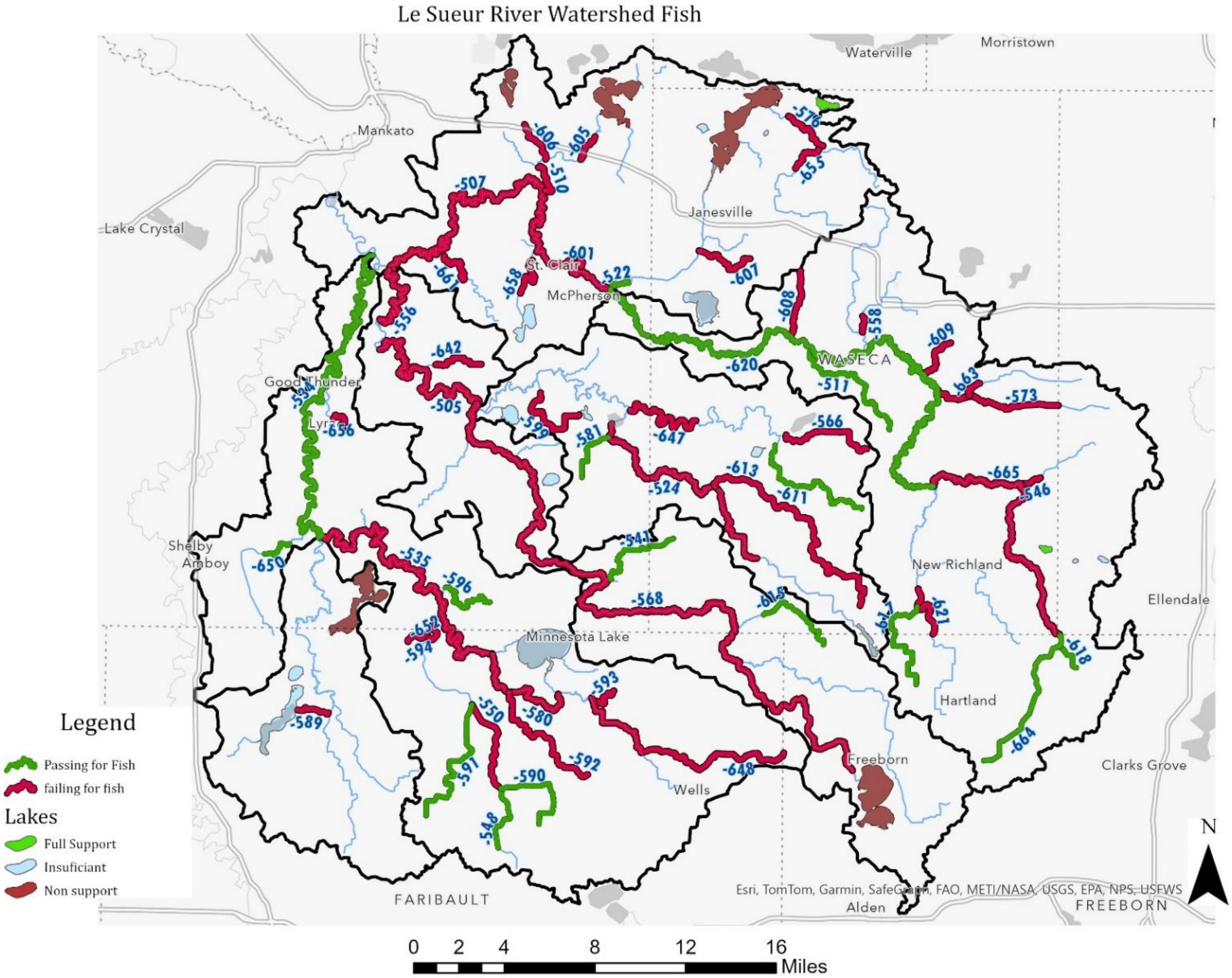
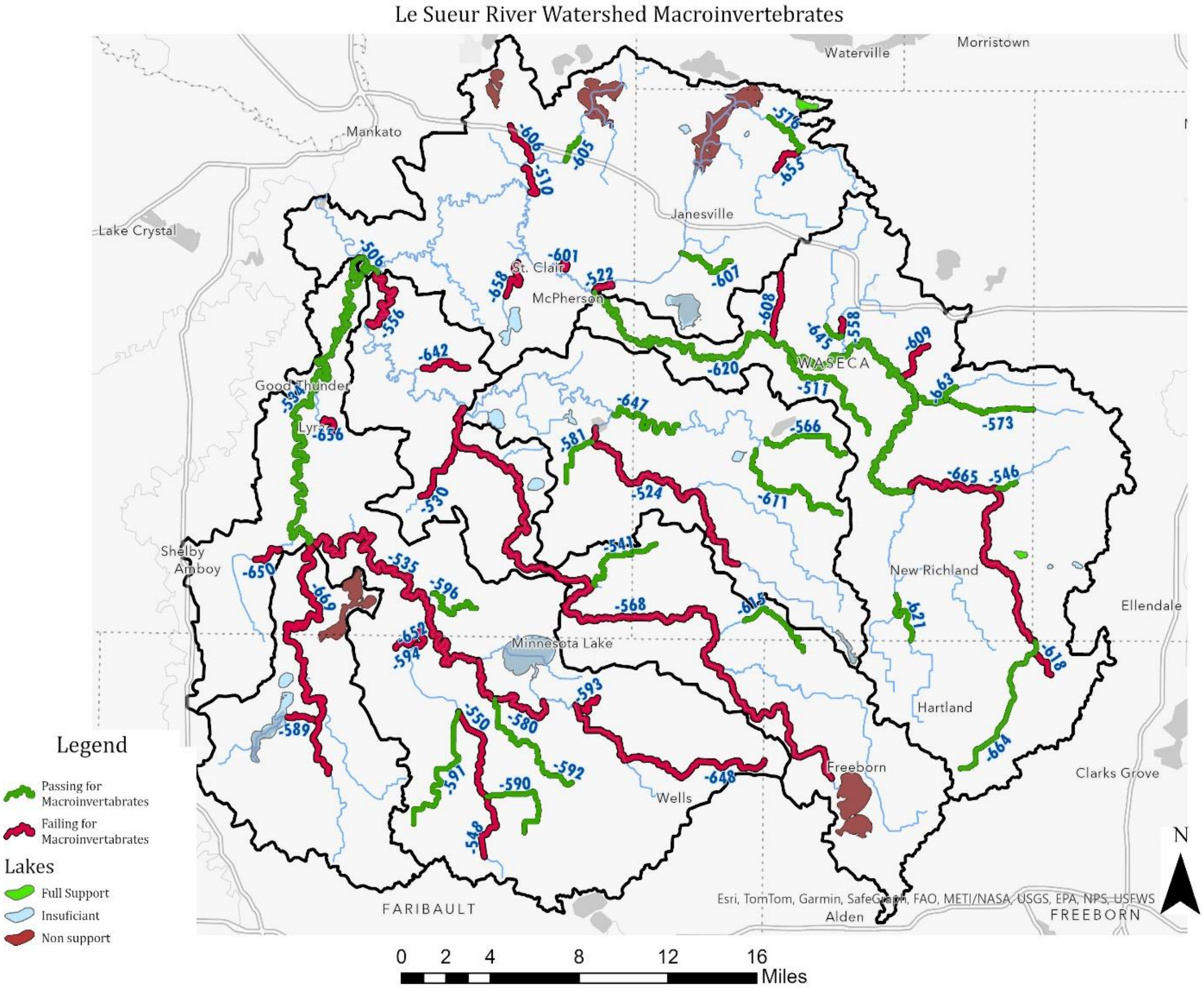


Figure 7. Current Macroinvertebrate impairment status within the Le Sueur River Watershed



Evaluation of candidate causes

3. Updated findings of possible stressors to biological communities (Cycle 2)

Identification of a set of candidate causes is an important early step in the SID process and provides the framework for gathering key data for causal analysis. A candidate cause is defined as a "hypothesized cause of an environmental impairment that is sufficiently credible to be analyzed" (EPA 2012). A more detailed description of possible candidate causes or stressors specific to Minnesota is provided in the document Stressors to Biological Communities in Minnesota's Rivers and Streams (MPCA 2017). This information provides an overview of the pathway and effects of each candidate stressor considered in the biological SID process with relevant data and water quality standards specific to Minnesota. The EPA has additional information, conceptual diagrams of sources and causal pathways, and publication references for numerous stressors on its CADDIS website. IBI scores can be found in the appendix of this report.

Summary of candidate causes in the Le Sueur River Watershed

Candidate causes were selected as possible drivers of biological impairments in the Le Sueur River Watershed. Each of the candidate causes is discussed in detail below.

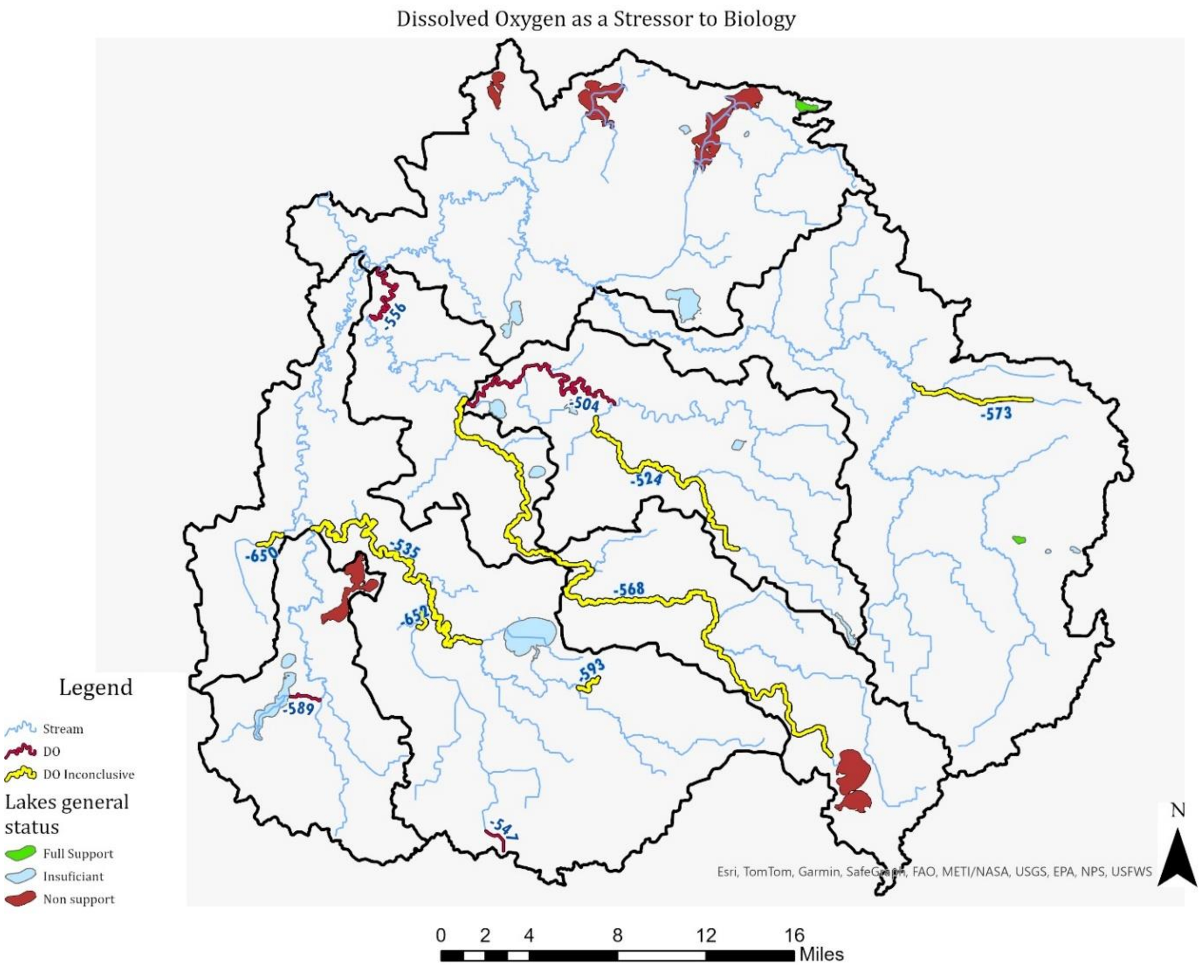
- Dissolved Oxygen (DO)
- Eutrophication
- Nitrate
- TSS
- Habitat
- Connectivity
- Altered Hydrology

Low dissolved oxygen

Overview of dissolved oxygen in the Le Sueur River Watershed

Figure 8 highlights the Le Sueur River Watershed WIDs with low DO following the 2018 Cycle 2 biologic assessment. Most often these cases correlated with eutrophic conditions. DO is critical for aquatic life. Signs of low DO stress within a biological community often exhibit as loss of diversity, as well as interruption of species life cycle. When evaluating low DO as a biological stressor, streams that fall below 5 mg/L for DO are found to limit aquatic life.

Figure 8. Streams with low dissolved oxygen biologic stressors within the Le Sueur River Watershed.



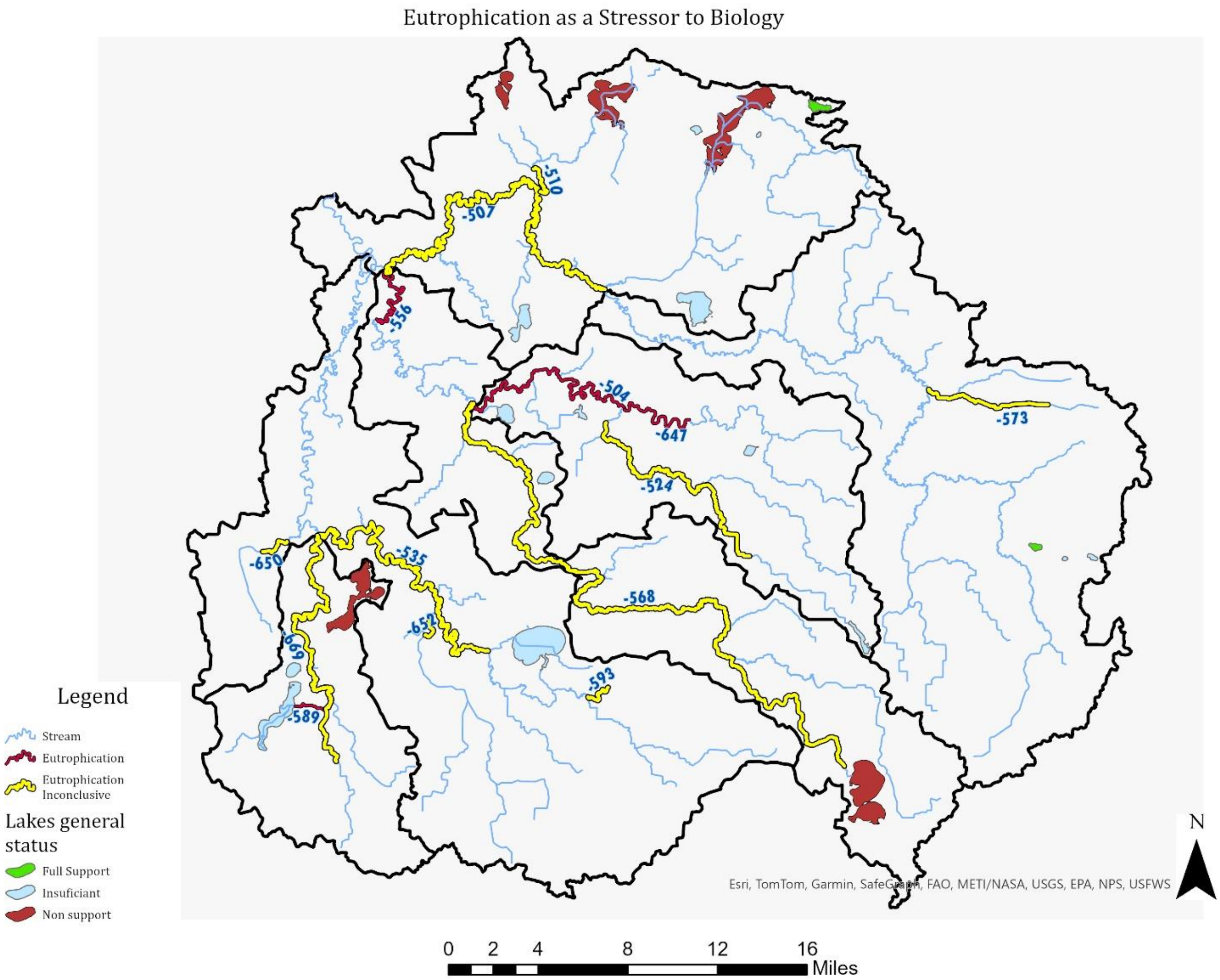
To evaluate for DO, two different collection methods were conducted for analysis and is shown in point measurements were for instantaneous DO data and is available throughout the watershed. These types of measurements can be used as an initial screening for low DO. Point measurements represent discrete point samples, usually conducted in conjunction with surface water sample collection utilizing a sonde. Diurnal, or continuous, measurements were used where warranted. Yellow Springs Instruments (YSI) sondes were deployed for numerous days throughout the Le Sueur River Watershed in summer months to capture diurnal fluctuations over the course of several diurnal patterns to measure the amount of 24-hour DO fluctuation (diurnal flux). For additional information on low DO in stream systems, as well as the drivers refer to EPA's CADDIS Dissolved Oxygen webpage.

Eutrophication

Overview of eutrophication in the Le Sueur River Watershed

Eutrophic conditions (Figure 9) were identified in the headwater areas of stream systems during SID analysis after the 2018 Cycle 2 biological assessment or low gradient sections of the stream that have slow flow conditions. Often, findings were inconclusive from the result of poor data.

Figure 9. Streams with low Eutrophic biologic stressors within the Le Sueur River Watershed.



In the headwaters, phosphorus loading is high due to agricultural contributions, paired with the stream modifications, that have led to losing natural riparian shading, as well as more water surface area within the stream. These upland portions of the watershed are also low gradient, which provides for increased residence time for pollutant loading and growing time for both sestonic and benthic algal growth.

River eutrophication is harmful to aquatic life in several ways, with the primary impacts in this watershed being noted as reduced DO, as well as reduced transparency. In some cases, eutrophic streams will lead to habitat impairments as organic matter begins to settle and smother the streambed. For additional information on eutrophic streams and biologic impacts, refer to the EPA's CADDIS Nutrients webpage.

There are several standards that are evaluated when determining eutrophic conditions. The river eutrophication standard for the Southern River Nutrient Region is a maximum TP concentration of 150 µg/L or 0.15 mg/L (ROS 2024). Total phosphorus (TP) is the causative variable involved with this standard. Also, at least one response-variable must be above a threshold value, or out of a desired range. The appropriate response variables for the Southern River Nutrient Region are listed in Table 3.

Table 3. River eutrophication standards used within the Le Sueur River Watershed.

Parameter Southern Nutrient Region	
Total phosphorus	150 µg/L
Chlorophyll-a	35 µg/L
Dissolved oxygen flux	≤4.5 mg/L
Biochemical oxygen demand	≤3.0 mg/L
Periphyton density	150 mg chlorophyll a / sq. meter

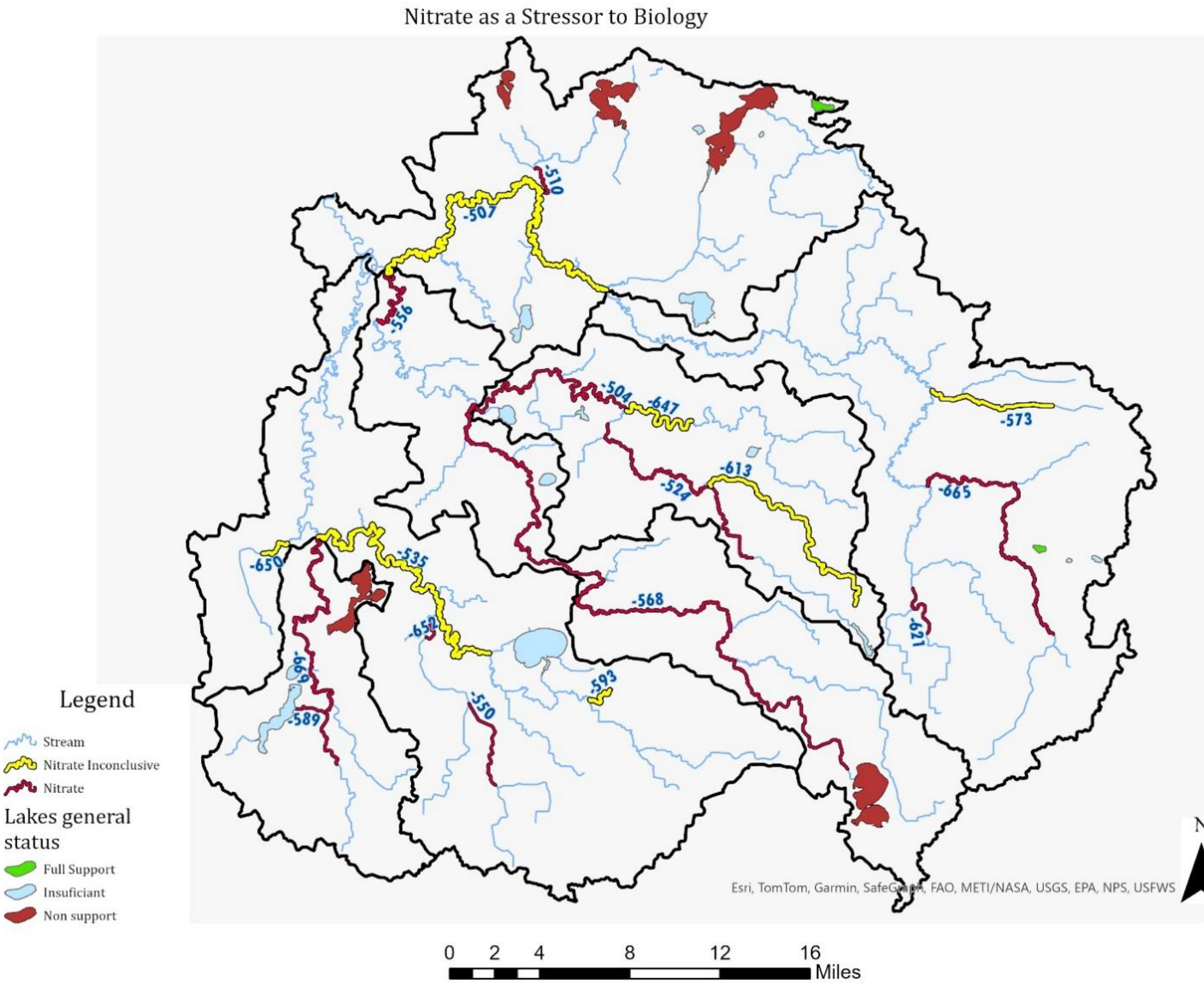
Ecoregion data are available to show if specific data from the Le Sueur River Watershed are within the expected range (Inventory of water quality standards projects, 2021 – 2023, with status as of November 2023 (state.mn.us)).

Nitrate

Overview of nitrate in the Le Sueur River Watershed

Nitrate was found to be a stressor in 10 assessed streams in the Le Sueur River Watershed (Figure 10). Lack of data left six of the streams as inconclusive for finding nitrate to be a significant limitation to biology.

Figure 10. Streams with nitrate stressors within the Le Sueur River Watershed.



Nitrogen pollution is thought to be one of the greatest threats to biodiversity worldwide (Díaz-Álvarez et al. 2018). Nitrate can directly impact aquatic organisms as it may be toxic by itself or exacerbate other environmental stressors. While macroinvertebrate communities tend to have a weaker threshold for nitrate stress, fish communities can be impacted at any life stage once hatched. This may be indicated within a fish sample in the form of deformities, stunted growth, low survival rates, and taxa diversity (Gomez Isaza et al. 2020).

There is not a statutory nitrate standard set for aquatic life for the state of Minnesota. The MPCA proposed an 8 mg/L nitrate standard for aquatic life in warm water streams and 5mg/L for cold water streams, found in the Aquatic Life Water Quality Standards Technical Support Document for Nitrate. Included within this support document is a list of specific macroinvertebrate species and their respected thresholds for nitrate. For additional information on nitrate related to biology, reference the EPA's CADDIS nutrient website. For the purposes of the Le Sueur River Watershed SID assessment, sample values over 10 mg/L are considered "elevated."

Nitrogen is commonly applied as a crop fertilizer. Seventy-five percent of the Le Sueur River Watershed consists of row cropland and various forms of nitrogen including nitrate and anhydrous ammonia are likely being applied throughout the watershed. The specific timing and rate of nitrogen fertilizer application is unknown, but nitrogen isotopes could assist in the source identification of excess nitrate in future monitoring. When water moves quickly through the soil profile (as in the case of heavily tiled watersheds) nitrate transport can become significant.

Figure 11. Statewide nitrogen pathways to surface waters pie chart, taken from statewide nitrogen study (MPCA 2013).

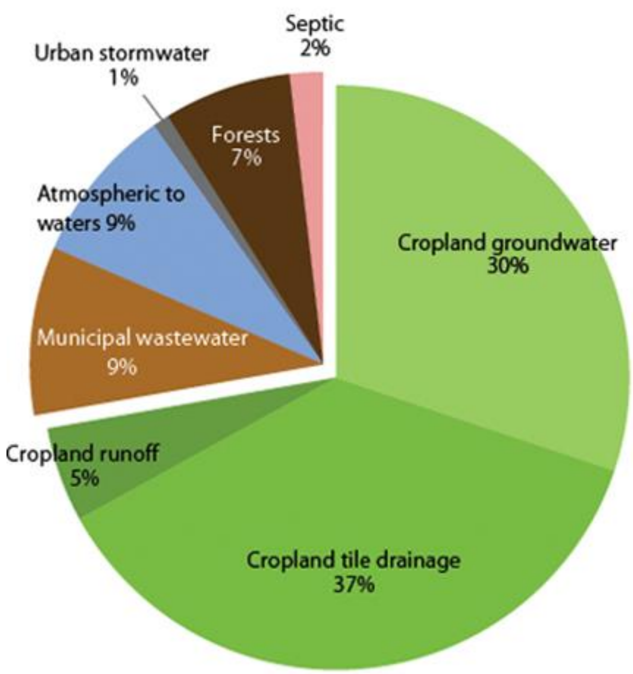


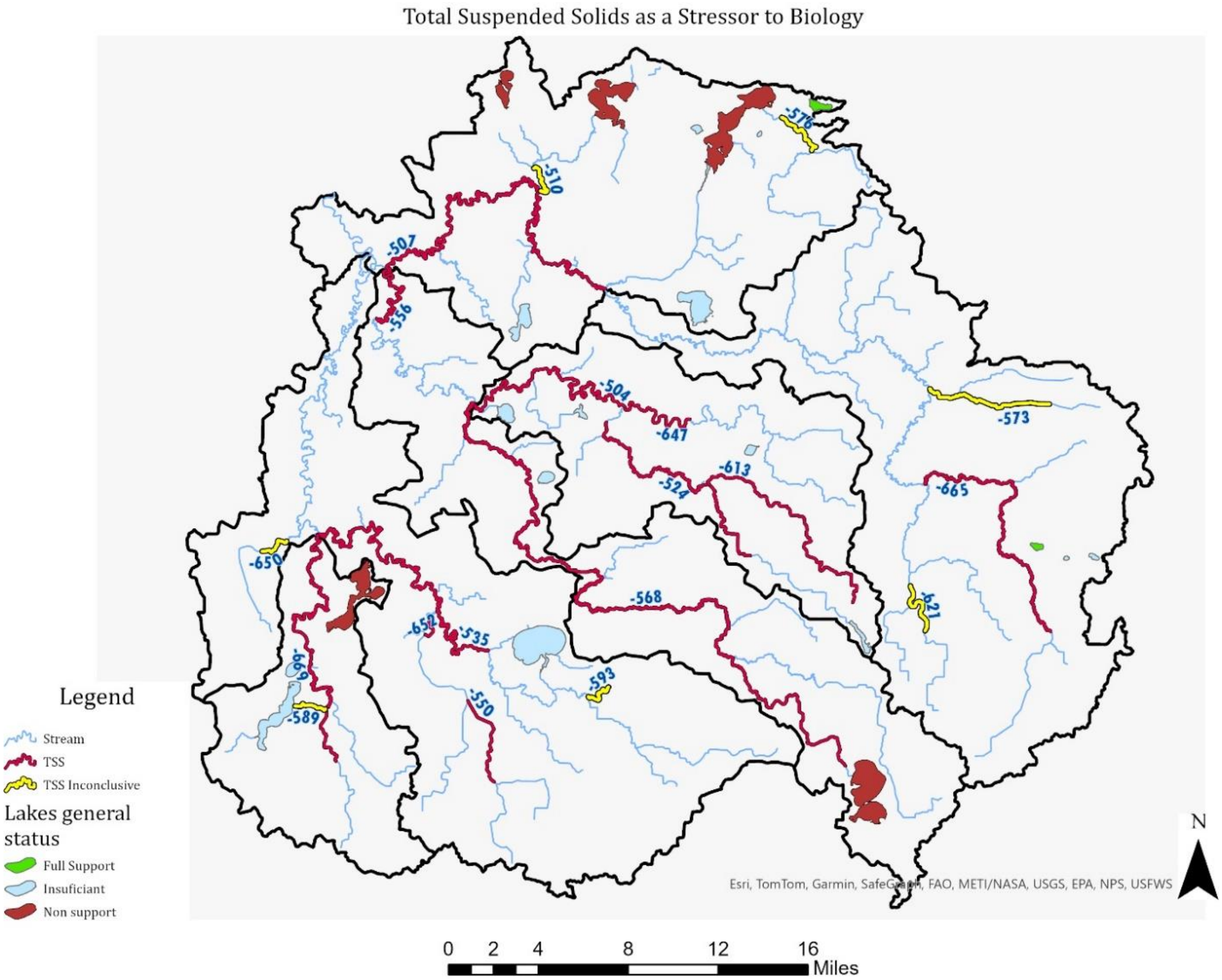
Figure 11 shows the results from a statewide nitrogen study that found cropland commercial fertilizers make up 47% of nitrogen added to the landscape, 21% occurs through cropland legume fixation, 16% from manure application, and 15% from atmospheric deposition (MPCA 2013). Nitrogen can reach waterways through surface runoff, tile drainage, and leaching to groundwater, with tile drainage being the largest pathway (MPCA 2013). For long term trends in nitrate and other pollutants in our state see MPCA's Pollutant Concentrations trends.

Total suspended solids

Overview of TSS in the Le Sueur River Watershed

Out of all the pollutant parameters, TSS resulted in the most biological stressors within the Le Sueur River Watershed, as shown in Figure 12. There were seven headwater stations were inconclusive.

Figure 12. Streams with TSS stressors within the Le Sueur River Watershed.



TSS within the Le Sueur River Watershed is found primarily in the form of sediment as well as total suspended volatile solids (TSVS), often as suspended algae. TSS in impaired streams will often have impacts on the stream's biology both directly (such as damaging fish gills, or smothering eggs) as well as indirectly (as seen in loss of habitat features and changes to the natural DO regime). The TSS criteria are stratified by geographic region and stream class due to differences in natural background conditions resulting from the varied geology of the state and biological sensitivity. The TSS standard for the southern region of the state has been set at 65 mg/L.

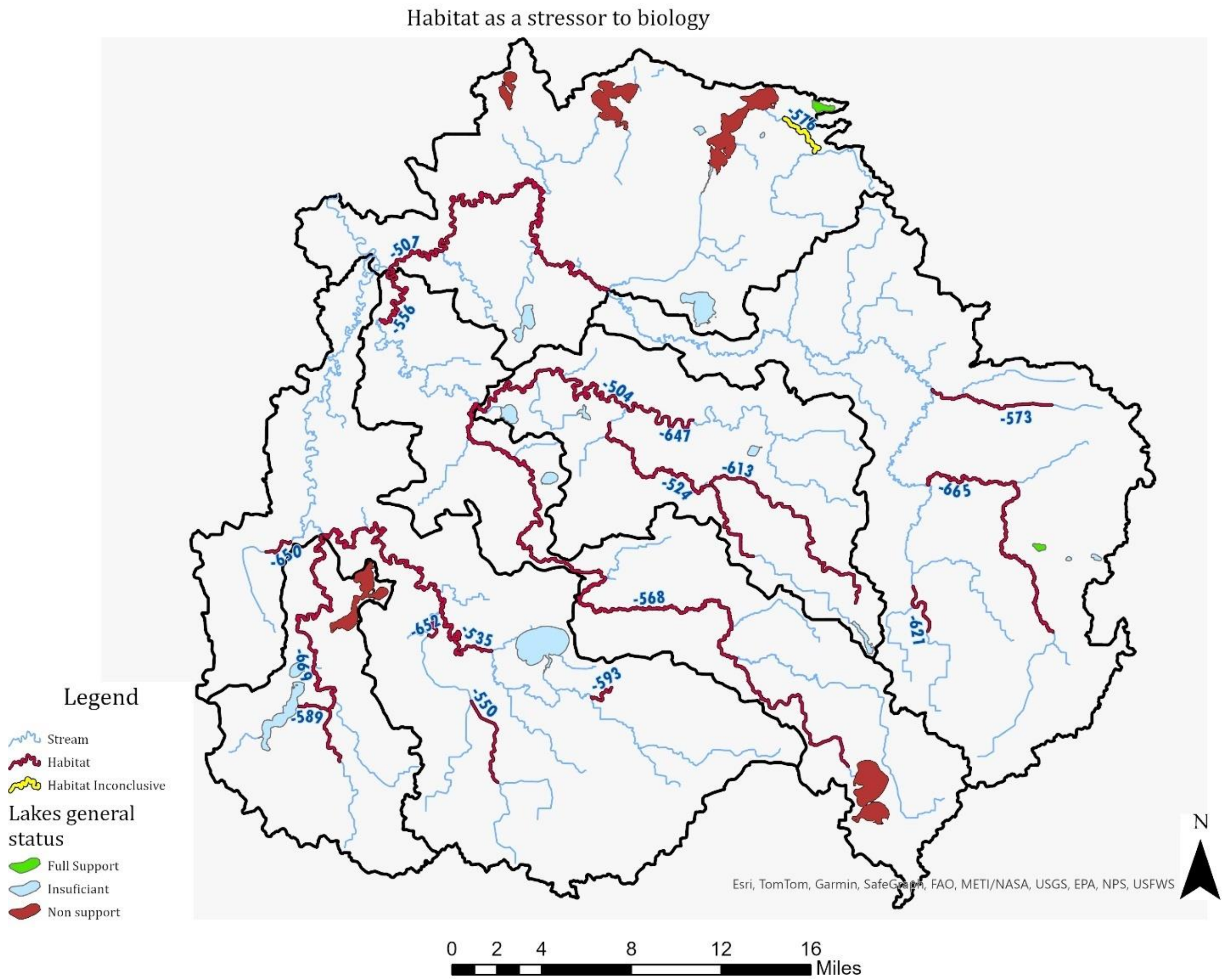
In stable streams, sediment loads created by erosion from a meandering stream channel will be balanced out by deposition. However, anthropogenic changes to the landscape and direct channel modifications are thought to have thrown off the balance between erosion and deposition abilities (Leopold et al 1964).

Habitat

Overview of Habitat in the Le Sueur River Watershed

Habitat was one of the most common stressors found within the Le Sueur River Watershed (Figure 13), often because of physical alterations, or impacts of TSS.

Figure 13. Streams with habitat stressors within the Le Sueur River Watershed.



Loss of habitat was a common identified stressor throughout the Le Sueur River Watershed. Habitat is often degraded by way of physical stream modification for agricultural ditching and channelization. As habitat diversity is eliminated, and the natural stability of the stream becomes compromised, erosive banks, poor substrate, and lack of vegetative cover are often found at and downstream of these modified waterways. Areas with acceptable habitat conditions were often located downstream of headwater locations. This contributed to the land use on these steep gradients being highly vegetated, providing both stream stability (mitigating erosion) as well as shade and refuge. These steep gradients allow fine sediments to wash through, resulting in diverse and clean riverbed substrates. For additional narrative and the habitat conceptual model, reference the EPA’s CADDIS habitat webpage.

Lack of habitat is strongly connected to stream modifications (such as ditching) that eliminate physical habitat diversity; replaced by homogenous features throughout the stream. In addition to physical modification, excess fine sediment deposition on benthic habitat has been proven to adversely impact fish and macroinvertebrate species that depend on clean, coarse stream substrates for feeding, refugia, and/or reproduction (Newcombe et al. 1991). Aquatic macroinvertebrates are generally affected in several ways: (1) loss of certain taxa due to changes in substrate composition (Erman and Ligon 1988); (2) increase in drift (avoidance by movement with current) due to sediment deposition or substrate instability (Rosenberg and Wiens 1978); and (3) changes in the quality and abundance of food sources such as periphyton and other prey items (Pekarsky 1984).

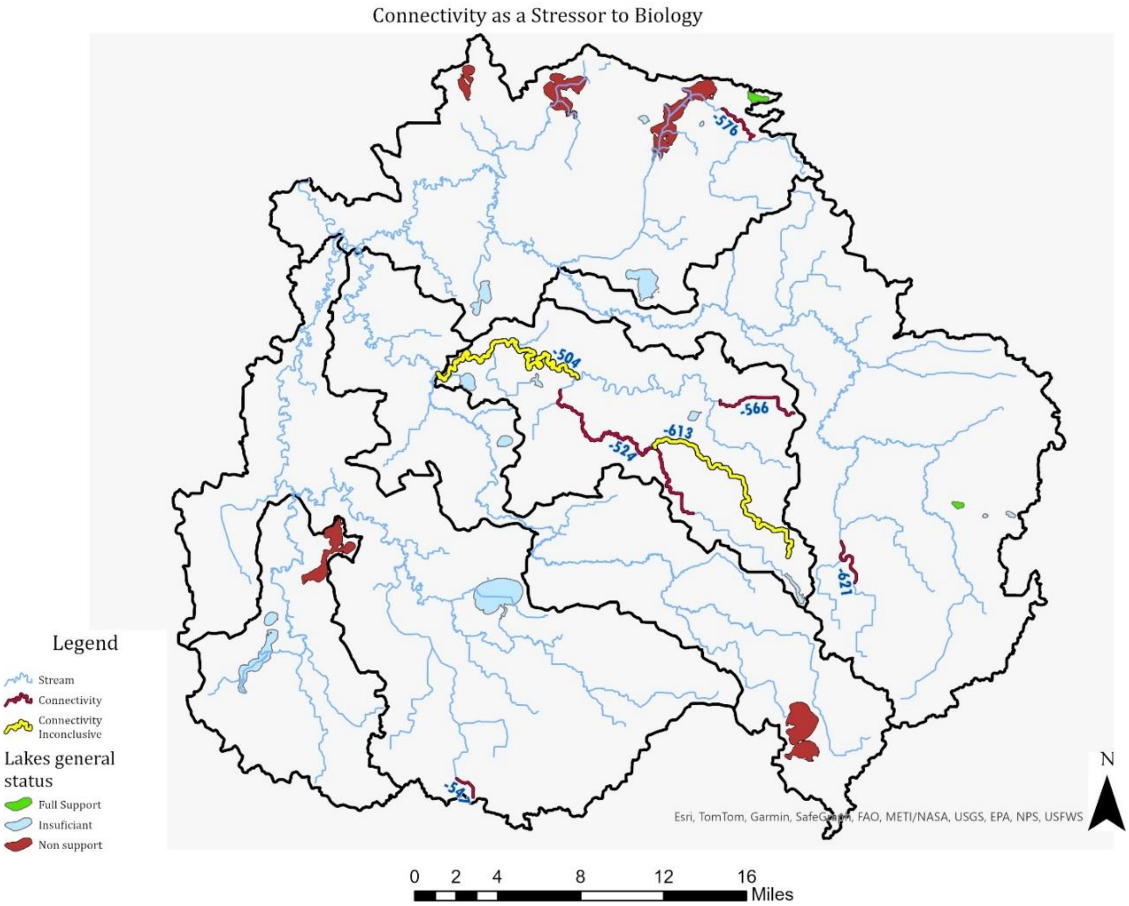
Fish communities are typically influenced through: (1) a reduction in spawning habitat or egg survival (Chapman 1988) and (2) a reduction in prey items because of decreases in primary production and benthic productivity (Bruton 1985; Gray and Ward 1982). Fish species that are simple lithophilic spawners require clean, coarse substrate for reproduction. These fish do not construct nests for depositing eggs, but rather broadcast them over the substrate. Eggs often find their way into interstitial spaces among gravel and other coarse particles in the streambed. Increased sedimentation can reduce reproductive success for simple lithophilic spawning fish, as eggs become smothered by sediment and become oxygen deprived. The sediments primarily responsible for causing an embedded condition in southern Minnesota streams are sand and silt particles, which can be transported in the water column under higher flows, or as a bedload component. When stream velocities and gradient decrease, these sediments can “settle out” into a coarser bottom substrate area, thus causing an embedded condition.

Connectivity

Overview of connectivity in the Le Sueur River Watershed

Connectivity was only clearly identified at four WIDs (Figure 14) in the Le Sueur River Watershed, one of the primary barriers to fish migration was often identified as perched culverts, or fish/carp barriers.

Figure 14. Streams with connectivity stressors within the Le Sueur River Watershed.



Connectivity in river ecosystems refers to how water bodies and waterways are linked to each other on the landscape and how matter, energy, and organisms move throughout the system (Pringle 2003). While the tendency is to consider this generally in a longitudinal manner (up-stream to downstream), there are also vertical, horizontal, and subsurface connections that are important to the overall ecology of the system.

Impoundment structures (dams) on river systems alter streamflow, water temperature regime, and sediment transport processes-each of which can cause changes in fish and macroinvertebrate assemblages (Cummins 1979; Waters, 1995). Dams also have a history of blocking fish migrations and can greatly reduce or even extirpate local populations (Brooker 1981; Tiemann et al. 2004). In Minnesota, there are more than 800 dams on streams and rivers for a variety of purposes, including flood control, wildlife habitat, and hydroelectric power generation. Beavers build dams to create impoundments with adequate water depth for a winter food cache. Beaver dams, even though natural, can also be barriers to fish migration.

Dams, both human-made and natural, can cause changes in flow, sediment, habitat, and chemical characteristics of a water body. They can alter the hydrologic connectivity, which may obstruct the movement of migratory fish causing a change in the population and community structure. The stream environment is also altered upstream of a dam to a predominately lentic (lake or “still water”) condition (Mitchell and Cunjak 2007).

Altered hydrology

Overview of altered hydrology in the Le Sueur River Watershed

Altered hydrology is identified as the driving stressor at every assessed stream impaired for biology the Le Sueur River Watershed. Altered hydrology is the change of the stream flow regime caused by human impacts. These impacts can include channel alteration, water withdrawals, land cover alteration, agricultural tile drainage, and impoundments or dams, to name a few. Hydrology within the Le Sueur River Watershed is complex and there are several factors that drive dramatic changes in stream hydrology and morphology. Due to the dominant land use of agriculture, most of the water storage as well as waterways in this watershed have been significantly altered to quickly move water off the landscape. One of the most dramatic impacts of this is increased stream flow velocity and water volume, which in turn will lead to negative direct and indirect effects on multiple biological stressors. As such, the hydrology is increasingly viewed as the key driver of the ecology. The alteration of flow regimes affects ecosystem structure and function, which may shift the dominance in native community assemblages and facilitate the invasion and success of exotic and introduced species (Bunn 2002). Altered hydrology influences several stressors directly and indirectly and is the primary driving force to the impaired biological communities in the Le Sueur River Watershed.

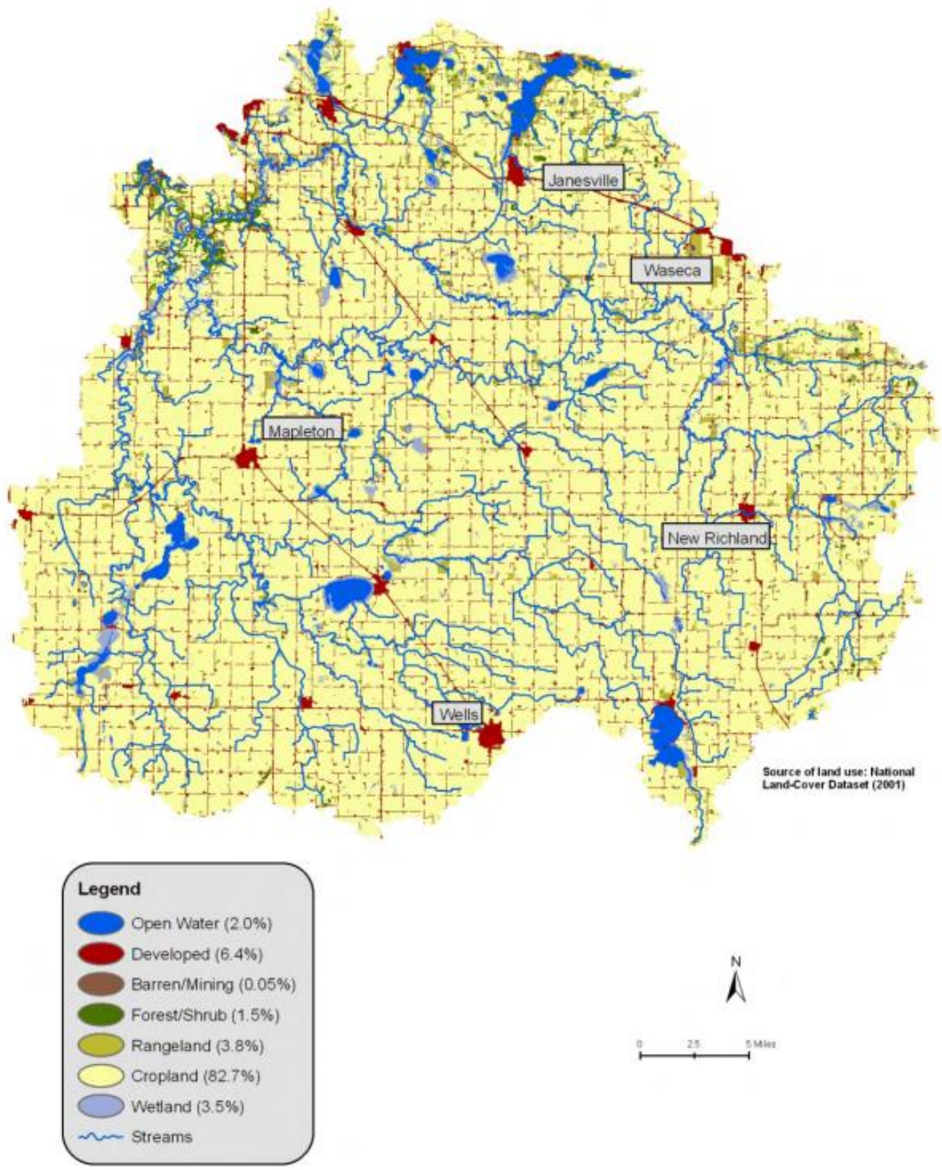
Channelization/ditching

Figure 15. Example of a channelized stream in the Le Sueur River Watershed.

Ditching is defined as the digging of a trench to divert water where no channel previously existed. Channelization is the process of straightening a preexisting natural channel, highlighted in Figure 15. Drainage ditches and channelized streams are a common feature in the Le Sueur River Watershed. Channelization and/or ditching changes the physical structure of a stream but will also change the flow regime for a waterway. The result is often increased peak discharges and reduced baseflow (Blann et al. 2009). As water is diverted from the landscape and routed through manmade or altered channels, there is a loss of habitat features. The habitat features that are commonly affected include loss of pool depth, increased embeddedness of gravel and cobble in riffles, loss of floodplain connectivity, and loss of woody material in the channel. Additionally, high flows can scour organisms and substrate from streambeds, while low flows can reduce habitat area and volume. Currently 65% of the Le Sueur River Watershed's tributaries are altered because of ditching for agricultural practices (Figure 16). Most of the alterations are in the headwater portion of streams where both direct and indirect impacts to the stream occur at the altered location as well as downstream.

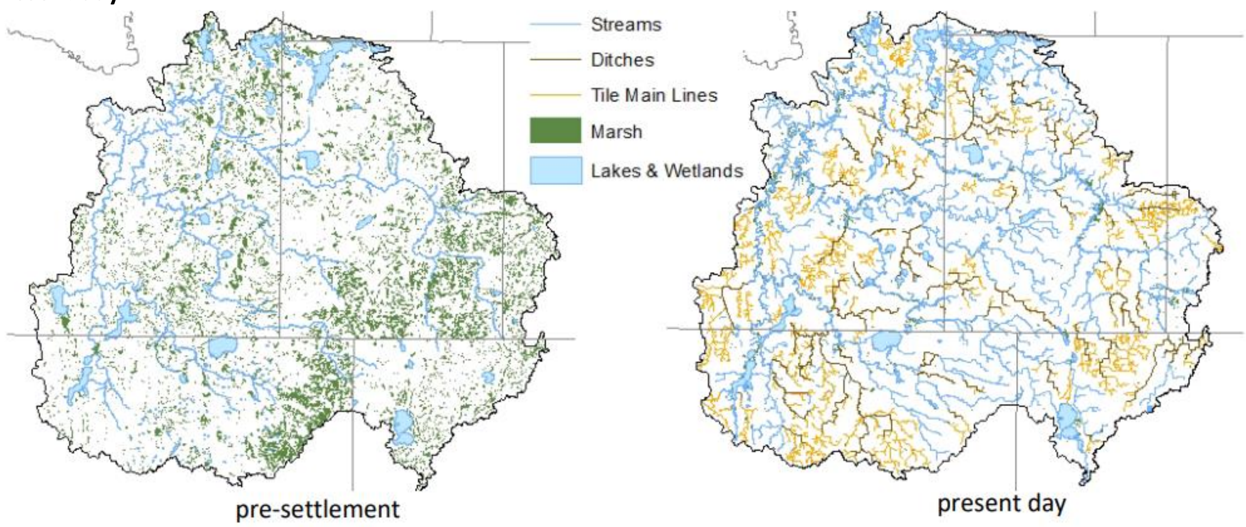
The peak flows in this watershed are a response to overland flow and shallow subsurface pathways. In urban or developed areas runoff can occur rapidly due to impervious surfaces, and peak flows can occur quickly. Cropland and the associated practice of subsurface drainage (tile drainage) are the dominating hydrologic influence on this stream system, as it applies to a majority of the watershed.

Figure 16. Le Sueur River Watershed highlighting land use and streams.



Agricultural tile drainage systems are used to intentionally reduce soil moisture by moving precipitation or irrigation waters from subsurface soils, through pipe, and eventually into ditches or streams and thereby altering timing and magnitude of flows. As shown in Figure 17, land use change resulting from historical wetlands that have been eliminated through drainage is significant. Although tile drainage can increase agricultural productivity, it has negative impacts on hydrology (e.g. increasing peak flows and reducing base flows) and water quality (e.g. increasing nitrogen loading and sediment transport). A study comparing changes in hydrology for 21 Minnesota watersheds, which included the Le Sueur, found that “artificial drainage was a major driver of increased river flow, exceeding the effects of precipitation and crop conversion” (Schottler et al. 2013). It was also noted that twentieth century crop conversions and the attendant decreases in evapotranspiration (ET) from depressional areas due to artificial drainage have combined to significantly alter watershed hydrology on a very large scale, resulting in more erosive rivers (MPCA 2015).

Figure 17. Le Sueur River Watershed highlighting pre-settlement streams and water boundaries compared to present day.



The inverse effect to an increase of stream flow with artificial subsurface drainage is seen in the reduction of base flow conditions. Within this watershed, there are times where tributary base flows drastically drop, or will dry up later in the year. This is largely because drainage within the Le Sueur River Watershed boundary can potentially lower groundwater tables and therefore reduce the near channel storage that otherwise sustains lateral drainage during dry periods (Blann et al. 2009). In spring to mid-summer, the hydrology within this watershed tends to be flashy, as water is quickly transported from land to streams via subsurface tile lines before crops are established. In mid-summer to fall months the river system in significantly less flashy and some of the tributary streams completely dry out, as the lateral water cycle cannot sustain base flow conditions.

Geomorphology and soils

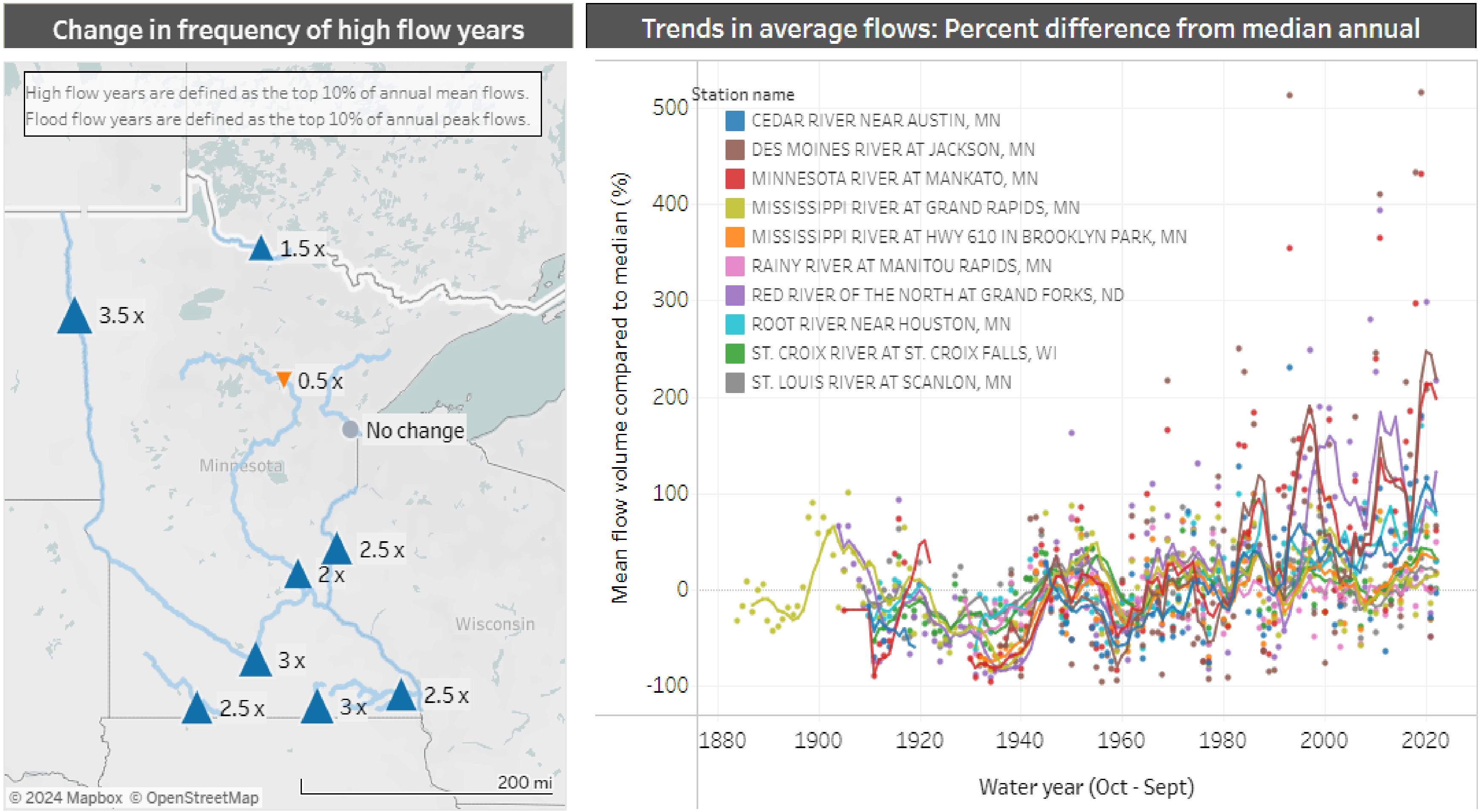
Soil types are an influencing factor when interpreting stream morphology and hydrology. Sediments delivered to the Le Sueur River are generally fine-grained and derived from lacustrine or glacial till sources. Soils that now reside in the flat upland portions of this watershed are typically high in organic matter and naturally are poorly drained, as many of the soils found today are remains of wetlands from pre-European settlement and prior to tile drainage. These wetland soil types allowed for land and stream equilibrium. One of the ways in achieving this was the ability of the wetland to exhibit long retention times during high flow periods. This would be particularly true in wetland class types with bi-directional and isolated hydrology. In general, these wetland types would be expected to have high pollutant assimilative and flood storage capacities, which benefit downstream waters and land (Lore 2016).

Climate and precipitation

Climate and precipitation change is another possible contributor to altered hydrology in the watershed. In a 2013 study done by Schottler et al, the relationship of river morphology and change in precipitation and land use was examined. It was found that while the Minnesota statewide spatial average of precipitation has significantly increased, in South Central Minnesota there has not been a statistically significant rise in yearly total rainfall over the previous 20 years. One regional study focused on the precipitation trends in this watershed as well as surrounding watersheds and found a shift in precipitation over two 35-year periods. These findings concluded that increased precipitation is occurring during the September through October months, whereas precipitation trends are staying the same or decreasing during May and June (Schottler et al 2013).

In most watersheds studied, drainage made up the biggest portion of change in annual water yield. In this same study, stream flashiness (a rapid increase in stream water volume) was found to be occurring more rapidly and at greater intensities during the months where little to no change in precipitation had been found. It is also important to note this is occurring well after thaw-out and snowmelt occurs, thus concluding that the seasonal hydrological changes observed are not the result of precipitation alone (Schottler et al 2013). While precipitation plays an important role in hydrology, the driving force on how the Le Sueur River Watershed is responding and changing is due to land use, primarily intense row crops and associated tile drainage, and ditching for expedited water transport off the land.

Figure 18. Flow trends throughout Minnesota's major rivers (USGS 2024)



Tips: Adjust filters above. Select data points to highlight flows for a focal station. Hover over lines and points for trends and more details.

Methods: Ten river monitoring stations were selected to represent the majority of the watersheds in Minnesota. The map shows the frequency of high flows during the timeframe selected compared to the historic record for each monitoring location. High flows are defined as the top 10% of flows for each location. In the graph, each point represents the flow in that water year (October-September) for that station. Lines represents the trailing five-year moving average in flow for each station. Zero represents no difference between the annual mean and historic median values. Positive values indicate greater than typical flow.

Tracking flow over years, there is a clear increase of water volume that continues to trend upwards in this region (Figure 18). This figure illustrates what is also occurring at the smaller scale in many of the tributaries and streams within the Le Sueur River Watershed.

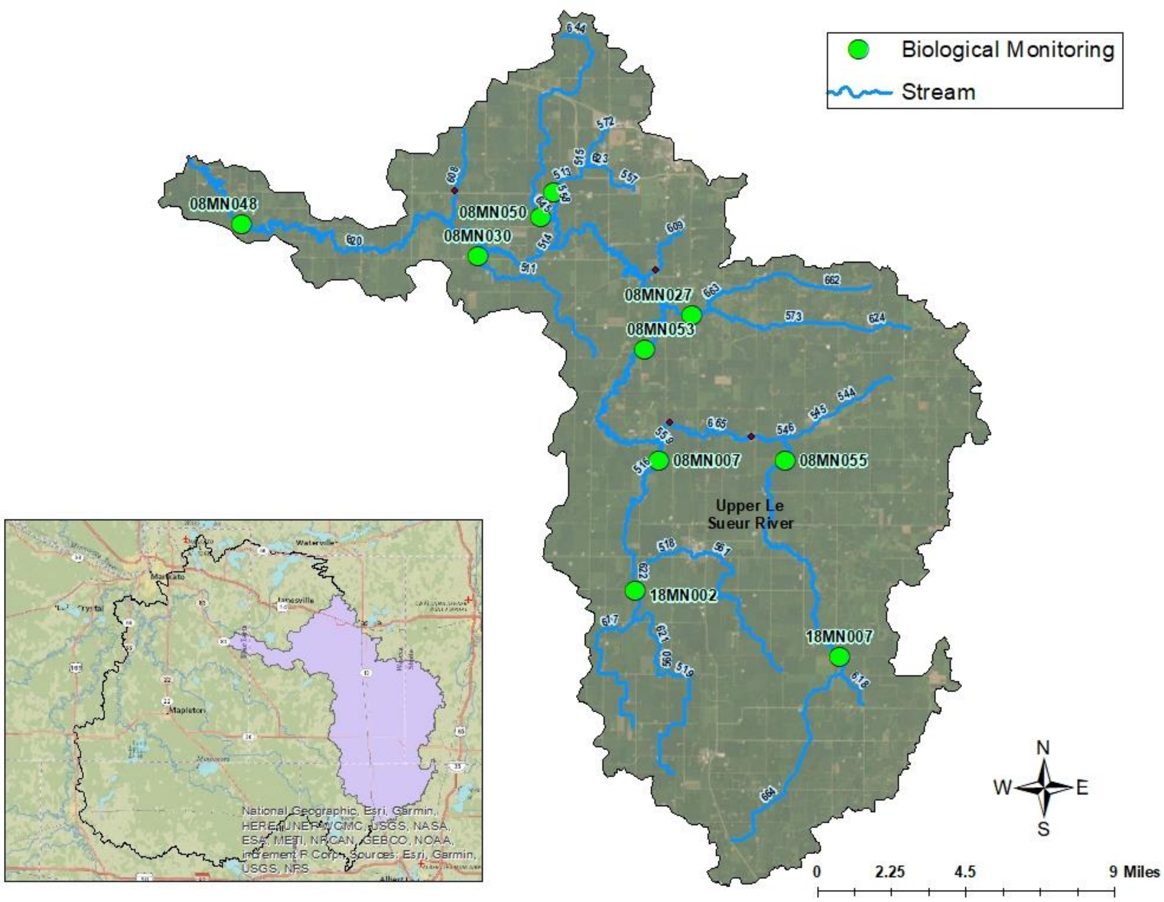
Altered hydrology directly and indirectly is negatively influencing the biology in the Le Sueur River Watershed, driving the biological stressors. Altered hydrology is the primary biological stressor as it is the contributor of pollutants to the stream via tile line (subsurface drainage). In addition, the loss of habitat is the result of directly altering the headwater streams to be channelized, or upstream channelized headwaters that contribute to increased flows and stream instability noted in sedimentation, and changes in stream velocity and water availability. Other ways physical alterations are driving stressors are noted barriers. While man-made barriers such as dams are a clear alteration, less obvious are perched culverts. In these cases, the barrier was a result of upland altered hydrology and flow that created the culvert to lose connectivity to the stream's bed.

4. Evaluation of candidate causes

Upper Le Sueur River (HUC-10 0702001101)

This report is a summary of findings. While some supporting evidence will be highlighted within the write up, most chemistry summaries and biologic metric scores will be found in the Appendix. Additional analytical data used in the assessment of these findings may also be available upon request. All biologic and chemistry findings can be found on the [Water Quality Assessment Results Data Viewer](#) (MPCA 2021). The term “Cycle 1” refers to the initial SID assessment from 2008 biological findings and “Cycle 2” is in reference to the current assessment from the 2018 biological findings. Figure 19 shows the streams and biological monitoring locations assessed for Cycle 2 in the Upper Le Sueur River Subwatershed.

Figure 19. Map of Upper Le Sueur River



Below in Table 4 is a summary of the assessed streams within the Upper Le Sueur Subwatershed and their relationship to stressors. Sites that were not assessed for this Cycle 2 Update are briefly addressed at the end of the section for this subwatershed.

Table 4. Summary table of Cycle 2 SID assessment for the Upper Le Sueur Watershed.

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	**Stream Name**	**Biological Stations**	**Impairment**	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Upper Le Sueur																					
664	Le Sueur River	07MN057 18MN007	Support																			
665	Le Sueur River	08MN055	F-IBI M-IBI								•				•	•	•			•		
621	Boot Creek	92MN076	F-IBI								•				•		•	•	•	•	•	•
620	Le Sueur River	08MN048 08MN053	Support																			
573	Little Le Sueur	08MN027	F-IBI	•			•		•		•	•			•	•	•	•	•	•		•
511	County Ditch 35	08MN030	Support																			

Key	
	Inconclusive
	Stressor
	Not a stressor
•	Potential Driver

07020011-664 Le Sueur River

This headwater stream of the Le Sueur (WID-644) is one of the few streams that was consistently found to be in full support of aquatic life within the Le Suer River Watershed for both Cycle 1 and Cycle 2. Stream conditions at the time of the fish sample are shown in Figure 20 below.

Figure 20. Biological monitoring stations on the headwaters of the Le Sueur River (WID-664).

The fish sample at station 07MN057 occurred in the summer of 2007 and 2008. Both samples scored above the threshold for a modified stream. Station 18MN007 was added as part of the 2018 Cycle 2 biological assessment on this stream. As shown in the community metric data (attached Appendix), over the course of the sampling events in 10 years, there was not an increase to the overall fish IBI score. However, there was a slight decline in the tolerant community. In Cycle 2 there were not any fish found with Deformities, Eroded fins, Lesions, and Tumors ([DELTS] black spots were noted in the Creek Chub community in Cycle 1). There was also an increase in lithophilic spawners that generally require specific habitat needs to thrive. Cycle 2 highlighted the emergence of pioneer species. This would likely be due to the ditch cleanout that occurred in 2017 (Figure 21). It is likely that if the ditch clean out had not occurred, the overall IBI could have increased. Macroinvertebrates were not found to be impaired in the original Cycle 1 assessment. The community was made up of both sensitive and tolerant taxa, yet all functional groups were found to be appropriately distributed throughout the system. Macroinvertebrates were not sampled in 2018 for Cycle 2.

Figure 21. Ditch clean out conditions on October 19, 2017 at WID -664.

07020011-618 County Ditch 46

In 2008, biological assessment at station 08MN069 found that while the fish community was sufficient for this modified stream, the macroinvertebrate assemblage indicated an impairment. As there was not a follow up sample at this WID in Cycle 2, it is difficult to assess if this impairment still exists. There are some correlations that may be made from the supporting WID previously discussed sampled in 2018 (-664). WID-618 conjoins to WID -664 just upstream of the new station 18MN007. Cycle 1 macroinvertebrate sampling found similar macroinvertebrate communities to WID -664, while the fish IBI surpassed the score of any samples in WID–664.

In addition to similar biologic indicators, habitat is often one of the primary limiting factors to biology. Nearby land use, riparian zone, substrate, canopy cover, and channel morphology of streams are quantitatively assessed using MPCA Stream Habitat Assessment (MSHA) scoring. As shown in Figure 22, the habitat similarities and scores are similar between the stations at the passing WID of WID-664 and the historically impaired -618. Note that the new station of 18MN007 was omitted from the graph as recent clean out eliminated habitat that resulted in scores of nearly 0 across the entire set.

Figure 22. MSHA scores between WID -664 and -618.

Chemistry samples are limited for these two WIDs. Both Cycle 1 chemistry and fish samples occurred on June 25, 2008. 07MN057 (WID -664) and 08MN069 (WID -618) did show elevated nitrogen at 14 mg/L and 12 mg/L respectively. Phosphorus was also similar between the two sites with concentrations of 0.042 mg/L at 07MN057 and 0.061 mg/L at 08MN069. TSS concentrations were also similar at 9.2 mg/L and 18 mg/L respectively. Other parameters collected on the day of the sample were DO and pH. Both parameters fell within normal ranges at both locations but were not as similar due to the time of day sampled. A summary of chemistry data collected from 2008 to current is shown in Table 9.

The WID of -618 will require additional analysis and internal review to determine if the biological impairment from Cycle 1 can be removed. For now, WID -618 is highlighted as a stream that is vulnerable and at a tipping point for meeting aquatic life standards.

Table 5. Summary of chemistry samples collected at WID –618 and –664 collected as of 2018.

WID	Parameters	Samples	Min	Median	Max	Avgerage	Exceeding Standard	Units
07020011-618	Ammonia-N	1	0	0	0	0	0	mg/L
	Dissolved oxygen	1	15.9	15.9	15.9	15.9	0	mg/L
	Inorganic nitrogen	2	10.14	11.07	12	11.07	0	mg/L
	pH	1	8.25	8.25	8.25	8.25	0	
	Specific conductance	1	634	634	634	634	0	uS/cm
	Total Phosphorus	1	0.06	0.06	0.06	0.06	0	mg/L
	Total suspended solids	1	18	18	18	18	0	mg/L
	Transparency, tube with disk	1	53	53	53	53	0	cm
	Volatile suspended solids	1	2.4	2.4	2.4	2.4	0	mg/L
	Water temperature (C)	1	23.7	23.7	23.7	23.7	0	deg C
07020011-664	Ammonia-N	2	0	0	0	0	0	mg/L
	Dissolved oxygen	3	10.8	12.02	12.9	11.91	0	mg/L
	Inorganic nitrogen	6	5.3	12.87	21	12.81	0	mg/L
	pH	3	7.8	8.14	8.35	8.1	0	
	Specific conductance	3	6.3	651	654	437.1	0	uS/cm
	Total Phosphorus	4	0.03	0.05	0.55	0.17	1	mg/L
	Total suspended solids	4	3.2	13.6	340	92.6	1	mg/L
	Transparency, tube with disk	3	67	70	89	75.33	0	cm
	Volatile suspended solids	4	1.2	3.4	80	22	0	mg/L
	Water temperature (C)	3	23	27.1	27.4	25.83	0	deg C

07020011-665 Le Sueur River

Stations along WID -665 from upstream to downstream are identified as 08MN055, 10MN161, and 08MN029. The furthest upstream station of 08MN055 was the only station that was surveyed multiple times between Cycle 1 and Cycle 2 biological assessment. Nearly all fish communities in every monitoring year scored well below the expected threshold. Comparing the fish communities in 2008, 2010, and 2018, the overall dynamics that made up the fish sample did not change. Figure 23 shows the variety of monitoring conditions during three different years at monitoring station 08MN055 on the Le Sueur River.

Macroinvertebrate communities were consistently impaired throughout all monitoring cycles, with the most recent survey in 2018 resulting in the poorest community scores.

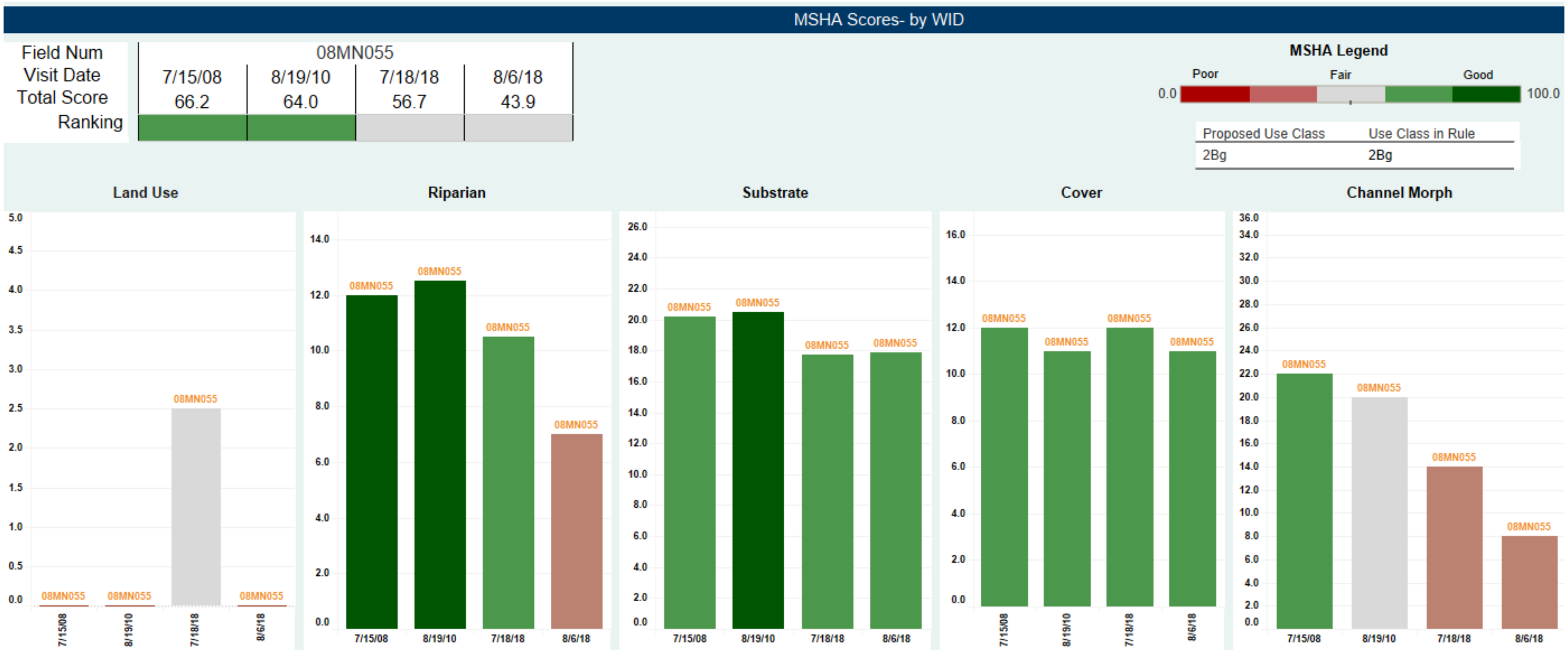
Figure 23. Monitoring conditions at 08MN055 during July 15, 2008 (left), August 19, 2010 (center), and July 18, 2018 (right).

Stressors to biology

While there are likely to be multiple parameters limiting biology, the fish sample indicated the population to be impacted by nitrates. In addition, the macroinvertebrate metrics consistently highlighted nitrate tolerant species. Tolerance values related to nitrate stress or displacement were four times higher than any of the other assessed biological stressors (when compared to DO, eutrophication, TSS, and habitat). In addition to the biological indicators, the few samples collected for nitrate were elevated. The other parameter that signaled community displacement in both fish and macroinvertebrates is TSS.

Both nitrate and TSS are tied to poor habitat stability and land use. As shown in Figure 24, the decline in channel morphology and continued nearby land use practice of row crops allows for altered hydrology to perpetuate these issues. There was a decrease noted in taxa diversity, as well as functional groups (climbers, clingers, burrowers, swimmers) that correlated to habitat degradation. The primary stressor within this section is altered hydrology by way of agricultural tile drainage.

Figure 24. MSHA scores of WID – 665 at station 08MN055 (2008, 2010 and 2018).



Inconclusive or nonstressors

Phosphorus levels were found to be elevated in the samples. However, while there were a few tolerant fish and macroinvertebrate types that thrive in algae dominant areas, there was not a strong indication that biology was limited by eutrophic conditions. Based on metric scores and DO samples, neither DO or eutrophication are found to be limiting factors to biology. Based on presence of migratory fish species in samples, there does not seem to be a barrier that impacts connectivity.

07020011-621 Boot Creek

This section of Boot Creek was a new sample location added in Cycle 2 (2018) at monitoring station 18MN002 (Figure 25). While the macroinvertebrate community scored a little above the threshold, the fish failed to meet the threshold. The fish community was made up of mostly tolerant, generalist species, that have short life spans. However, there was a single hog sucker (sensitive species) in the sample that was found to be over the age of three, in addition to a couple of mature golden redhorse.

Figure 25. Monitoring conditions at 18MN002 during July 17, 2018 (left), August 6, 2018 (center), and May 10, 2023 (right).

Stressors to biology

There is a direct barrier by way of a perched culvert within this WID (Figure 26). While there were some migratory species noted in the fish sample, during times of low flow this culvert will impact the ability for some to successfully complete their life cycle.

While the barrier is a direct stressor to fish, the driving force is a chain reaction of altered hydrology disrupting the stream's natural morphology. This is highlighted in the MSHA scores reflected in Figure 27 and the unstable channel. At the time of the habitat survey, the stream was noted as moderately embedded by silt with a complete absence of riffle features. This would account for the lack of benthic species as well as riffle dwellers.

Figure 26. Perched culvert at WID –621 on Boot Creek on.

Figure 27. MSHA scores for WID -621 on Boot Creek, 2018.

In addition to the perched culvert and habitat impacts, nitrate is also a stressor to biology at this location. At the time of the fish sample, nitrate was elevated at 13 mg/L. Multiple samples were assessed for nitrates and often measured above 10 mg/L, with the highest at 16 mg/L. The fish community does indicate nitrate as a stressor as there was a complete lack of sensitive species. Taxon types that are rated as “tolerant” to “extremely tolerant” specifically to nitrates were the dominant form present. There were also some lesions and black spots noted on fish from the sample that may be indications of nitrate stress. While macroinvertebrates were not impaired, nitrate sensitive taxa were completely absent from the sample. When comparing taxa tolerance values, the data strongly highlighted that nitrate significantly displaced portions of the population.

Inconclusive or not a stressor

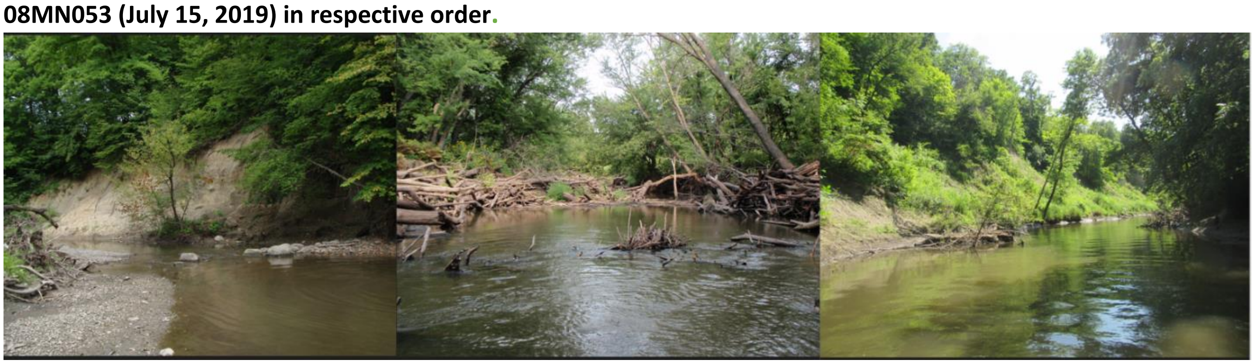
TSS is inconclusive due to conflicting biological metrics between the fish and macroinvertebrate response to this parameter. Fish IBIs do indicate some response to TSS that need to be interpreted with caution, as habitat loss can trigger similar indications. Macroinvertebrates and the limited chemistry samples did not indicate TSS to be a stressor. DO and eutrophication are not considered to be primary stressors to the fish community at this location.

07020011-620 Le Sueur River

Section 07020011-620 of the Le Sueur River is the largest section assessed within the upper Le Sueur River Subwatershed. This was originally designated as WID-619 with a previous biological impairment based on the fish community and discussed in the first published SID report in 2014 (MPCA 2014). At that time, stressors within this section were found to be TSS driven by altered hydrology. While recent biological data shows the fish community has improved enough to be listed as not impaired, this stream should be considered vulnerable and at high risk for aquatic life. Therefore, WID -620 is highlighted within this report.

Fish and macroinvertebrates have been sampled multiple times throughout Cycle 1 and Cycle 2 on this WID. Macroinvertebrates remained consistent in their scores for support while the fish community is showing an improving trend. 08MN048 was sampled once in 2008 and in 2019. 08MN053 was sampled in 2008, 2010, and 2019. The upstream and downstream WIDs of this site both have current fish impairments. As Figure 28 below highlights, the stream’s channel is rated as having moderate to severe bank erosion. While this section of stream is supporting biology, it is important to highlight how vulnerable it is to degradation in the future.

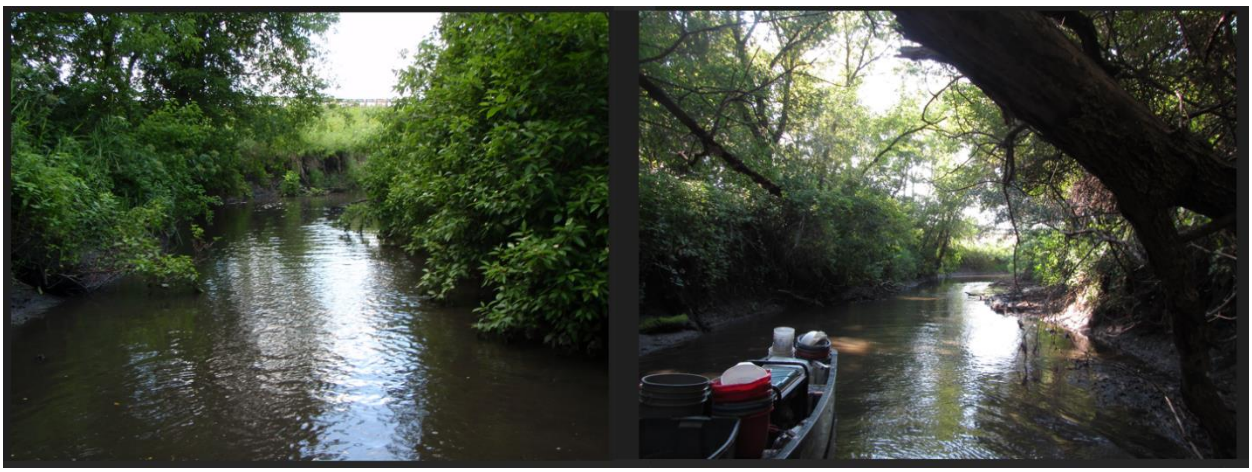
Figure 28. WID -620 at the time of monitoring at 08MN053 (August 13, 2008), 08MN048 (August 14, 2018), and 08MN053 (July 15, 2019) in respective order.



07020011-573 Little Le Sueur River

WID -573 is a small headwater stream with a single biological station of 08MN027, sampled in both Cycle 1 and Cycle 2 to assess for fish and macroinvertebrates (Figure 29). The macroinvertebrate community in 2008 and 2018 scored above the threshold, with a slight improvement in scores noted with the most recent survey. The fish community remained consistent in both Cycle 1 and 2 with scores just below the threshold. Taxa count and species types were consistent. The 2008 and 2018 samples had fathead minnows as the dominant species, with the overall population being composed of generally tolerant species. However, there were some sensitive or pollutant-intolerant species also found in both assessments. A species that may be of special interest to note in 2008 was mature northern hog sucker. In the 2018 sample, there were multiple Iowa and banded darters found.

Figure 29. Monitoring conditions at 08MN027 on July 21, 2008 (left) and August 8, 2018 (right).



Stressors to biology

There were three habitat surveys performed, with two of them occurring in 2018 and the other in 2008 (Figure 30). Habitat is noted as one area of concern, particularly impairments around the channel's morphology limitations. The fish community reflected benthic habitat displacement, as riffle dwellers and lithophilic spawners both were found in small numbers (less than half of what would be expected for this stream). The nearby land use of this stream is a combination of natural forest and prairie vegetation (found in the middle of the stream system) with other large sections both upstream and downstream of this WID surrounded by row crops. This has resulted in the upstream section of the stream being physically altered by way of channelization.

Figure 30. MSHA scores on WID -573 at station 08MN027.

During the habitat survey there was documentation of mass erosion of stream banks, as well as heavy siltation of the stream bed. Riffle features seemed to decline in the last 10 years as this process progressed (Figure 25).

Figure 25. 08MN027 bank erosion and siltation of stream on August 7, 2018.

Inconclusive or not a stressor

There were several parameters shown as inconclusive or not a stressor at WID -573. TSS is considered inconclusive due to a lack of chemistry data as well as conflicting results within the biological metrics. It would stand to reason that when there is erosion and sedimentation occurring to this degree, there is a high probability that suspended solids could be impacting aquatic life. Water quality data is limited to three samples during this assessment period, where both TSS and transparency tube readings each fell within the standard. In addition to limited sample values, the tolerance index values related to TSS do not show a clear limitation to the fish community. It is worth noting that in the last 10 years, there has been an increase of TSS tolerant species in this stretch.

Nitrate is inconclusive as a stressor. While there is indication within the tolerance make up in both the fish and macroinvertebrate community, it is not as prominent as others, yet still likely. Additional monitoring is needed to confirm. DO and eutrophic metrics did not indicate high tolerance values within the fish community. However, there was an odor (potentially anoxic bacteria) and DO saturation values were on the low end at the time of the fish sample. Eutrophication is also a potential stressor as there was a fair amount of benthic algae noted in the 2018 samples in addition to phosphorus values that were right at the standard of 0.15 mg/L.

Migration barriers are not a stressor as reflected in the fish sample.

07020011-511 County Ditch 35

Figure 31. Monitoring station 08MN030 at the time of fish sample on July 22, 2008 (right) and July 15, 2018 (left).

County Ditch 35 (07020011-511) is of significance as it is one of the few streams within the Le Sueur River Watershed that significantly improved between Cycle 1 and Cycle 2 (Figure 31). The most recent 2018 fish survey showed an increase in sensitive species, more taxa diversity, and a decrease in both tolerant and generalist species. The macroinvertebrates also had an increase in overall diversity as well as more sensitive species that made up the population. This stream is particularly noteworthy as it is fully modified as a channelized ditch. It is not common to see biological improvements of this magnitude within a highly altered stream. The subwatershed of CD 35 displayed the highest amount of implemented best management practices to reduce water pollution between Cycle 1 and Cycle 2 monitoring (Healthier Watersheds).

Limitations to data in Cycle 2 Upper Le Sueur River Subwatershed (nonassessed)

07020011-558 County Ditch 12

The 08MN020 Cycle 1 sampling in 2008 resulted in an aquatic life impairment as both fish and bug assemblage fell below the expected threshold. Cycle 1 SID found habitat and altered hydrology to be the primary stressors. Cycle 2 resampling did not reoccur at this location.

07020011-608 County Ditch 12

County Ditch 12 was sampled in 2008 at station 08MN049 for Cycle 1. Fish and invertebrates were found to be impaired. SID work found that habitat and altered hydrology were the primary stressors. This site was not resampled for Cycle 2.

07020011-609 County Ditch 15

The 08MN051 biological samples in 2008 and 2010 resulted in an aquatic life impairment as both fish and bug assemblage fell below the expected threshold. Cycle 1 SID found habitat and altered hydrology as the primary stressors at that time. Cycle 2 resampling did not occur at this location. Furthermore, current chemistry data is lacking. It is impossible to determine if these communities have improved over the last 10 years. This site does have some indications of having a cold-water influence at times, as some cold-water species were seen in the 2008 sample. There have been some measurements of cold-water temperatures but not enough to indicate this would be a cold or cool water stream. Continuous temperature monitoring should be considered if this site is re-evaluated in the future.

07020011-645 County Ditch 38

One invertebrate visit was completed at one station (08MN050) in 2008. The initial findings were not incorporated into Cycle 1 as this is a modified stream. Once thresholds were developed, the invertebrate community was found to be passing. For the fish assessment there was one visit completed in 2008 as part of Cycle 1 watershed monitoring. The fish community was found to be impaired. While there was an unaddressed fish impairment for WID -645 in Cycle 1, there was not an additional follow up for Cycle 2 to reassess the community. As shown in the 07020011-511 County Ditch 35, there may be some changes in nearby land use that made positive impact to the stream in this area. However, without additional monitoring it is not possible to make accurate SID findings for the historic fish impairment.

07020011-618 County Ditch 46

This stream was not able to have SID performed in Cycle 1, and without additional sampling for Cycle 2 it is difficult to determine what stressors are present. One invertebrate visit was completed at one station (08MN069) in 2008. The macroinvertebrate community did not resemble what this stream type should support and looked more like a tolerant wetland community. Taxa diversity was lacking. The fish community scored better and was found to be in support.

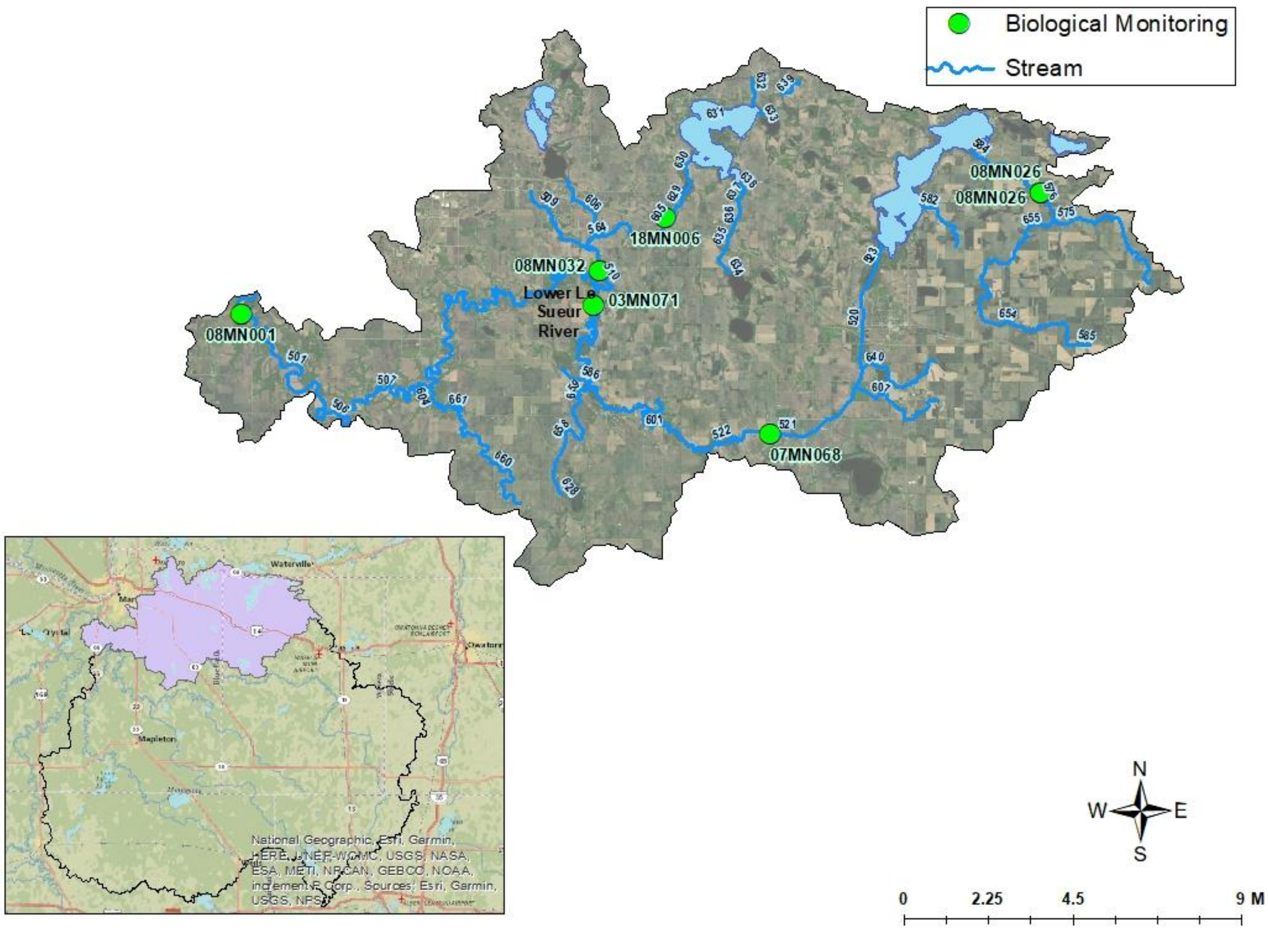
07020011-663 Judicial Ditch 10

One sampling visit was completed at one station (08MN054) in 2008 and invertebrates were found to be in full support while the fish community was found to be impaired. Sensitive taxa were nearly absent, with 99% of the species rated as “tolerant.” Due to lack of data, and not being resampled in Cycle 2, SID is not able to assess.

Lower Le Sueur River (HUC-10 0702001106)

This report is a summary of findings. While some supporting evidence will be highlighted within the write up, most chemistry summaries and biologic metric scores will be found in the Appendix. Additional analytical data used in the assessment of these findings may also be available upon request. All biologic and chemistry findings can be found on the Water Quality Assessment Results Data Viewer (MPCA 2021). The term “Cycle 1” refers to the initial SID assessment from 2008 biological findings and “Cycle 2” is in reference to the current assessment from the 2018 biological findings. Figure 32 shows the streams and biological monitoring locations assessed for Cycle 2 in the Lower Le Sueur River Subwatershed.

Figure 32. Lower Le Sueur River



The below Table 6 is a summary of the assessed streams within the Lower Le Sueur Subwatershed and their relationship to stressors. Sites that were not assessed for this Cycle 2 update are briefly addressed at the end of the section for this subwatershed.

Table 6. Summary table of Cycle 2 SID assessment of the Lower Le Sueur Watershed, listed by WID.

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	**Stream Name**	**Biological Stations**	**Impairment**	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Lower Le Sueur																					
576	Iosco Creek	08MN026	F-IBI inc	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Inconclusive	Inconclusive	Inconclusive •	Inconclusive •	Inconclusive	Inconclusive	Inconclusive	Stressor •	Stressor •
507	Le Sueur River	03MN037	F-IBI	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Inconclusive	Inconclusive •	Inconclusive	Inconclusive •	Inconclusive	Inconclusive	Stressor	Stressor •	Stressor •	Stressor	Stressor	Stressor •	Stressor •	Not a stressor	Stressor •
510	Unnamed Creek	08MN032	M-IBI	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Inconclusive •	Inconclusive •	Inconclusive	Stressor •	Stressor •	Stressor	Inconclusive	Inconclusive •	Inconclusive	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Not a stressor	Stressor •
501	Le Sueur River	08MN001	F-IBI*	Potential delisting																		

Key	
(blue)	Inconclusive
(pink)	Stressor
(hatched)	Not a stressor
•	Potential Driver

07020011-576 Iosco Creek

This section of Iosco Creek is located roughly a mile and a half upstream from where it outlets into Lake Elysian. This lake is impaired by nutrients. Iosco Creek was identified as a high priority location, as there may be an opportunity to implement land improvement projects that help mitigate pollutant inputs that could improve this stream section.

Iosco Creek was sampled in both cycles at station 08MN026 (Figure 33). While the macroinvertebrate community was found to be in support, the fish community showed large variability throughout three separate samples. The station was originally sampled in 2008 and scored extremely low (12) for overall community IBI with the threshold being 55 (see Appendix). This first sample was made up of only 7 species, with 83 fathead minnows being the most abundant, followed by 5 white suckers. The stream was sampled again for Cycle 2 in 2018 after a period of high water. The IBI from this sample jumped up to 63.2, significantly above the general use threshold. However, a very different community of fish was collected. In this sample yellow perch and black crappie were both collected, while they were absent from the first sample. It is possible these fish moved into the stream from Lake Elysian as it is only a couple miles from the site. More tolerant species like fathead minnow and brook stickleback were noticeably missing. Because of the drastic change in IBI and persistent high water in 2018, the site was sampled again in 2019. The IBI from 2019 was zero. Only three species were collected, and included yellow perch, largemouth bass, and white sucker. Fewer than 25 fish were collected. With such drastic changes in IBI from the most recent samples it does not appear there is enough evidence to delist the stream, even with the high passing score from 2018. Additional biology sampling was requested to make a future determination.

Figure 33. Station 08MN026 taken at the time of biological monitoring on July 2, 2008 (right) and July 30, 2018 (left). The 2019 sample conditions were not photographed.

Chemistry data that was collected and analyzed for this site throughout the last 10 years, is shown below in Table 7. While most other sites that are discussed throughout this report have the chemistry data within the Appendix, this site is highlighted as a high priority location.

Table 7. Summary of chemistry data from the last 10 years at WID-576 in Iosco Creek.

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value
07020011-576	Ammonia-N	2	0.00	0.03	0.05	0.03
	Dissolved oxygen	3	8.34	9.31	9.72	9.12
	E.coli	89	40.40	717.00	24,196.00	2,664.92
	Inorganic nitrogen (nitrate and nitrite)	121	0.25	6.69	14.40	6.79
	pH	3	7.93	8.22	8.23	8.13
	Specific conductance	3	575.00	643.00	701.00	639.67
	Total Phosphorus	120	0.04	0.20	0.62	0.22
	Total suspended solids	120	0.00	18.00	207.00	23.84
	Transparency, tube with disk	89	8.20	37.20	100.00	41.83
	Volatile suspended solids	7	1.60	3.60	5.20	3.20
	Water temperature (C)	77	5.40	19.80	26.70	18.91

Stressors to biology

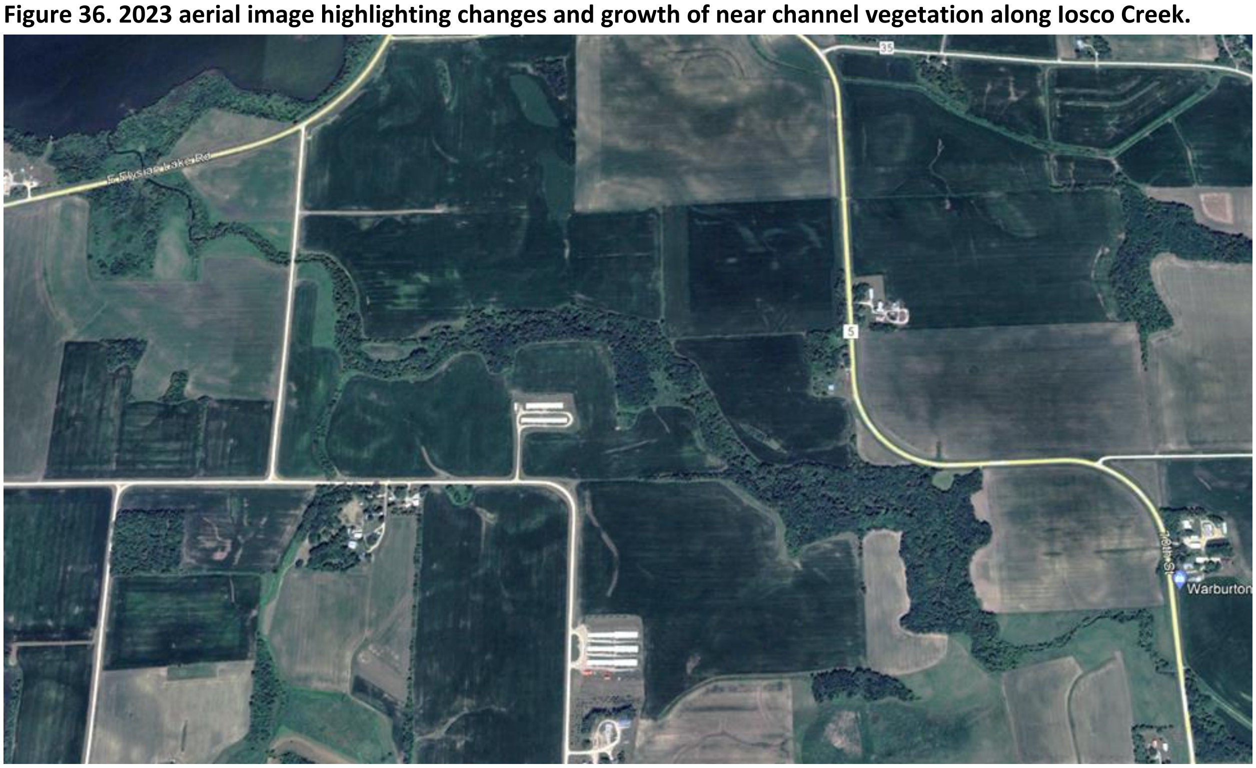
While there is some level of uncertainty around Iosco's fish impairment status, there is a clear trend of decreasing habitat, as shown in the MSHA scores in Figure 34.

Figure 34. MSHA scores for Iosco Creek on WID -576.

Notes of new channels forming and widening were noted at the time of biological monitoring. There is also a clear change in the stream's sinuosity and riparian area when comparing historic aerial imagery to current conditions (Figure 35 and Figure 36). Analysis of the photos indicates that as the stream is finding its equilibrium there are dynamic changes occurring, particularly within the stream bed and near channel.

Figure 35. Historic aerial image highlighting poor vegetation and channel alterations in 1991.

Figure 36. 2023 aerial image highlighting changes and growth of near channel vegetation along Iosco Creek.



When sampled in the future, it is plausible that Iosco creek will show an improved community and stable stream system. A majority of what is noted for habitat and erosion is the result of a historically modified stream finding its equilibrium. In time and with proper land use management, this stream will become more stable and maintain decent habitat. In addition to habitat concerns, migration ability does seem to still be limiting the fish community. The only migratory fish that were sampled in Cycle 1 were five white suckers, and the most recent survey only found one. No other migratory species were noted in any of the samples. There is a noted fish barrier on County Ditch 6 that prohibits fish from entering Lake Elysian from the larger stream systems.

Inconclusive or not a stressor

TP is of concern based on water chemistry samples measured at this site, as it exceeded the standard of 0.15 mg/L over 70% of the time sampled. There was some slight indication within the macroinvertebrate community that there could be some eutrophication displacement, yet not to the extent that algae eaters or nutrient tolerant species were overrunning the community. Multiple site visits to Iosco Creek did not note excess plant or algal growth. The strong canopy cover in addition to the gradient that is allowing for steady flow are likely mitigating factors to overabundant autotrophic growth. However, these concentrations pose a direct threat to the lake in continuous phosphorus loading. Lake Elysian was found to have a nutrient impairment in 2010 and does have an approved TMDL to address this impairment.

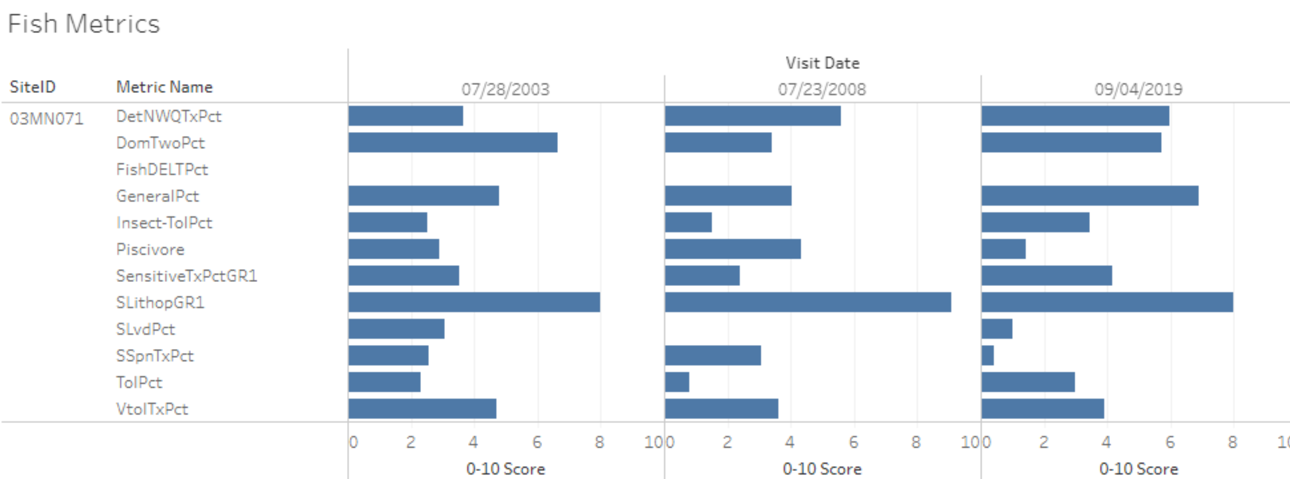
Nitrates at times are elevated, yet often were at lower levels in the last 10 years. In addition, the macroinvertebrate community did show improvement by the emergence of some nitrate sensitive species, with a decline in nitrate tolerant species. Nitrate is no longer considered a stressor. Connectivity is a problem as the outlet stream of the lake that converges with the Le Sueur River has a barrier. In both cycles, white sucker was the only migratory species found. In the last 10 years, their count dropped from 5 to 1 individual.

07020011-507 Le Sueur River

This section of the Le Sueur River (WID -507) has been sampled extensively for biology with sampling going back to 2003 at the downstream station of 03MN071 (Figure 37) identifying a fish impairment. In addition, WID -507 is a location for two pollutant load monitoring sites that allow for a better understanding of conventional parameters. Biology showed consistent scores throughout the sample periods, with all four samples of the macroinvertebrate community scoring above the impairment threshold. However, the fish community showed an impaired community in all samples across the years. Figure 38 highlights how consistent the fish population looked in each sample (see definitions in attached Appendix). There was a slight increase to detritivores, a decrease in piscivores, and lithophilic spawners decreased over time while serial spawners increased between 2003 and 2019.

Figure 37. Biological station 03MN071 during July 28, 2003 (right), July 23, 2008 (middle), and August 14, 2018 (left) samples.

Figure 38. Fish community metrics from 2003, 2008, and 2019 at 03MN071.



SID from Cycle 1 determined eutrophication, nitrate, TSS, habitat, and altered hydrology to be limiting factors to fish, while DO was found not to be a concern for the 2008 timeframe. This section is currently listed for a turbidity impairment.

Chemistry data for this section of the Le Sueur River is robust, as there are two Watershed Pollutant Monitoring Network (WPLMN) sites. One of the sites is located at the start of this assessed section, near St. Clair (Figure 39) and the other is located at the end of this WID near County Road 8 by Rapidan (Figure 40). The most change between the two is noted in the downstream increase of TSS (note the scale of reference changes between the two).

Figure 39. Graphs showing pollutant monitoring throughout the years at the upstream portion of WID-507 near St. Clair (black shows hydrograph, purple is sample point, green is model output).

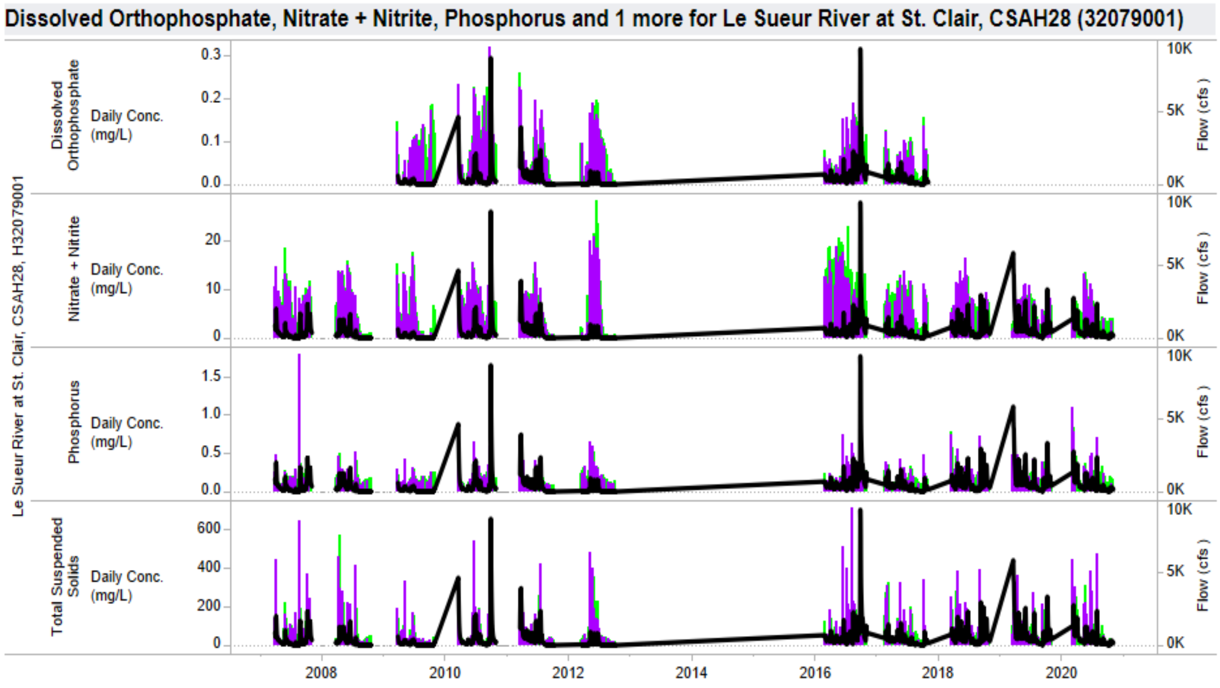
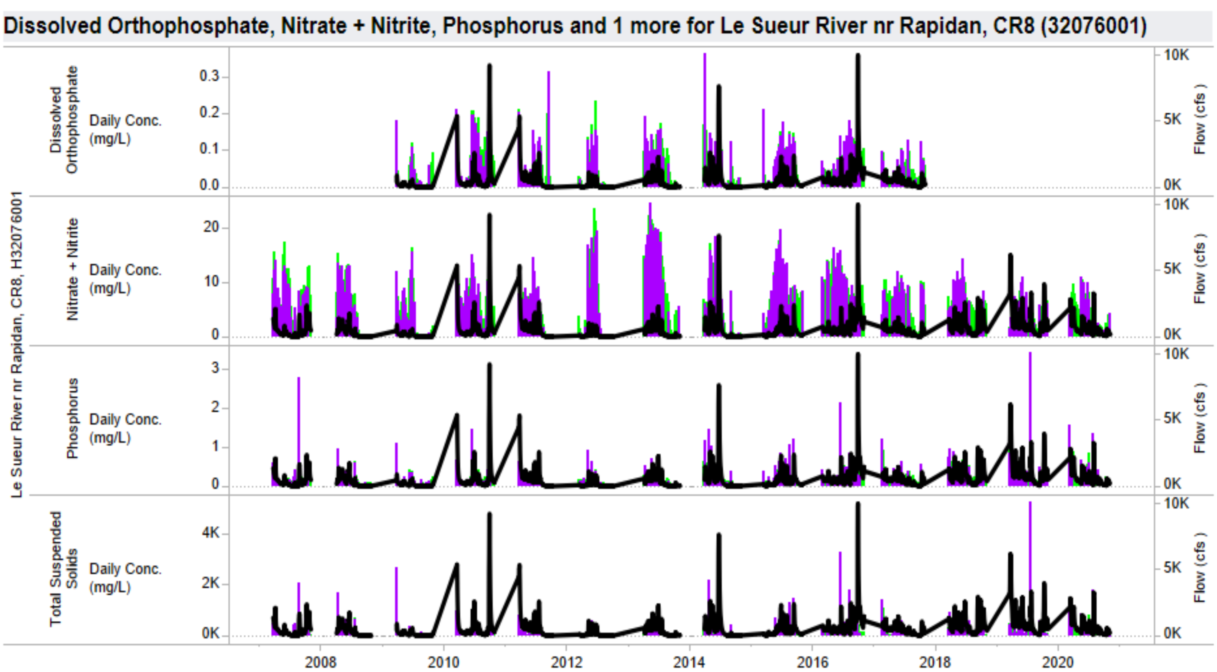


Figure 40. Graphs showing pollutant monitoring throughout the years, at the downstream portion of WID-507 near County Road 8 (black shows hydrograph, purple is sample point, green is model output).



Stressors to Biology

One of the more prominent stressors within WID -507 is TSS, as shown in community metrics with an absence or decline of TSS sensitive fish such as riffle dwellers or lithophilic spawners that need clean and diverse substrate for their life cycle needs. In addition, the chemistry data collected for this site shows high TSS potential. Habitat (Figure 41) is also a limiting component for the fish community, as there is not adequate substrate or stability. Nearby land use of agriculture drainage that promotes altered hydrology is the driving component for both stressors.

Figure 41. MSHA scores taken at the time of the biological sample on 03MN071 on WID -507.

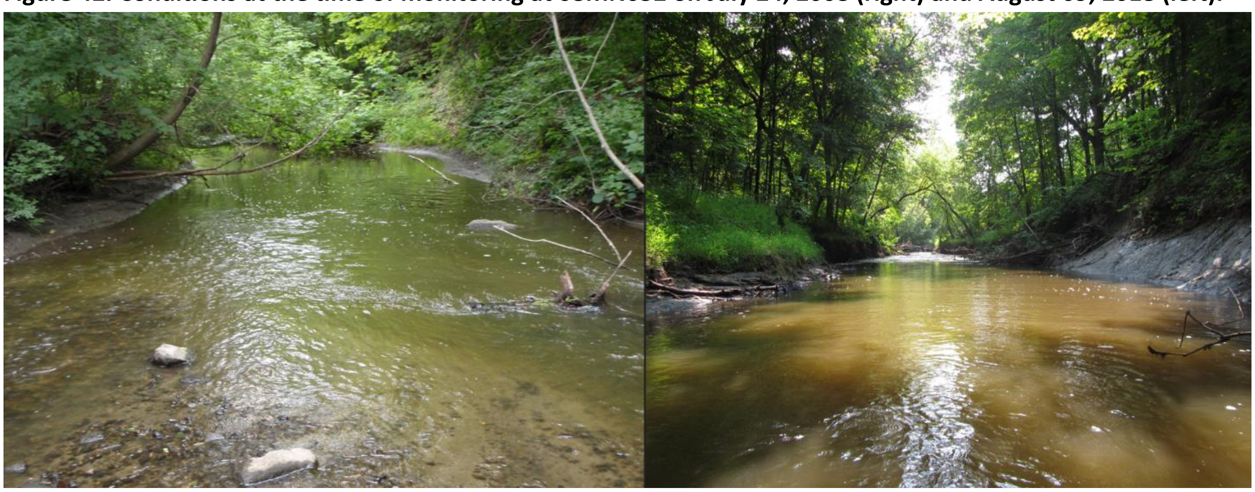
Inconclusive or not a stressor

While phosphorus and nitrate concentrations are of concern within WID -507 of the Le Sueur River, there is not a clear impact to the fish community, leaving eutrophication and nitrate as inconclusive. The nutrient loading that is captured should be noted as it is causing downstream impacts to other communities. There was not a negative community response to low DO, allowing for this parameter to be ruled out as a stressor. While migratory species fell slightly below the average, there are not any noted barriers. The lower number of recorded migratory species is likely the result of the overall community being limited by stressors such as TSS and degraded habitat.

07020011-510 Unnamed Creek

This unnamed tributary (WID -510) is the receiving water for both Madison Lake and Eagle Lake, before converging into the Le Sueur River mainstem WID of -507. There were two biological samples at 08MN032 (Figure 42); the first in Cycle 1 in 2008 and again for Cycle 2 in 2018. Samples resulted in a macroinvertebrate impairment, while the fish community marginally met standards. There was a decrease to overall IBI scores between the two years for inverts. Taxa count collected dropped significantly between the 10 years (42 to 28 taxa types) with tolerant species increasing. There were shifts to the functional community primarily seen in the increase of filter feeding species and scrapers and a decline in predators, shredders, and gatherers.

Figure 42. Conditions at the time of monitoring at 08MN032 on July 24, 2008 (right) and August 09, 2018 (left).



Stressors to biology

Out of all the tolerance metrics, the macroinvertebrate community showed the strongest negative response to nitrate values. While there is limited chemistry data to understand the pollutant loading potential, the nearby land use is dominated by agriculture that allows for a clear pathway for nitrate. In addition to altered hydrology via tile lines, the lakes are a likely source of nitrates.

Inconclusive or not a stressor

One of the most evident changes to the invertebrate community is the disproportionate increase of filter feeders and algae eaters sampled in Cycle 2. While chemistry data from this stream is limited, every sample collected for phosphorus exceeded 0.15 mg/L. However, there is not enough supporting information to say eutrophication is occurring at this location, especially as this could be a product of the upstream hyper-eutrophic lakes delivering excess algae. DO samples did not indicate low DO or flux is a stressor. In addition to adequate DO values, species that are sensitive to low DO increased between the two assessments, allowing DO to be ruled out as a stressor. As DO is often driven by eutrophication this leaves eutrophication itself as inconclusive. The stream's DO could be mitigated by other factors such as gradient, substrate, and springs. While there is clear evidence of a shift in algal eaters, additional investigation would be needed to determine if eutrophication is occurring locally at this location.

Notes taken at the time of biological sampling indicated an erosive and changing stream. In addition, the habitat scores do show a slight decline between the two cycles (Figure 43). With erosion, TSS metrics will often indicate sediment displacement and can be used as a line of evidence of habitat stress. However, there is an increase of filter feeders that should be driven down from sediment rather than increase. TSS often will limit diversity as it impacts habitat types and substrate. While the overall score did slightly decrease, habitat was found to be diverse and adequate.

Figure 43. MSHA scored taken at the time of the biological sample on 08MN032 on WID -510.

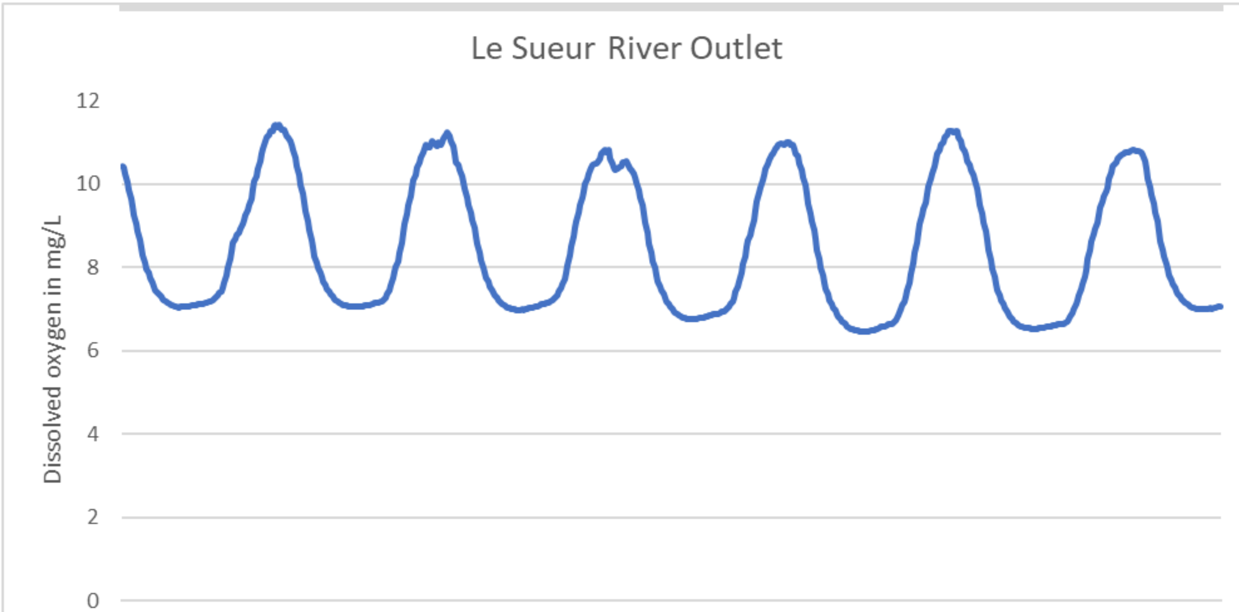
07020011-501 Le Sueur River Outlet

WID -501 is the outlet for the Le Sueur River Watershed as a whole, before it converges with the Blue Earth River and into the Minnesota River. In 2008 (Cycle 1), sampled macroinvertebrates were found to be in support for aquatic life while the fish community was impaired. SID from Cycle 1 determined eutrophication, nitrate, TSS, habitat, and altered hydrology to be limiting factors to fish, while DO was found not to be a stressor (MPCA 2014). As shown in Figure 44, flow was low at the time. Cycle 2 sampling found a similar macroinvertebrate community as compared to Cycle 1 and as before, was found to be passing. The fish community showed improvement in both diversity and overall IBI score. However, the status of the aquatic life impairment was determined to be inconclusive as additional monitoring was recommended to truly determine if this location merits delisting. While this WID is currently listed as inconclusive for an aquatic life impairment, upstream mitigation efforts for identified stressors will help improve this WID's overall community as well.

Figure 44. Conditions at biological station 08MN001 during Cycle 1 sampling August 7, 2008.

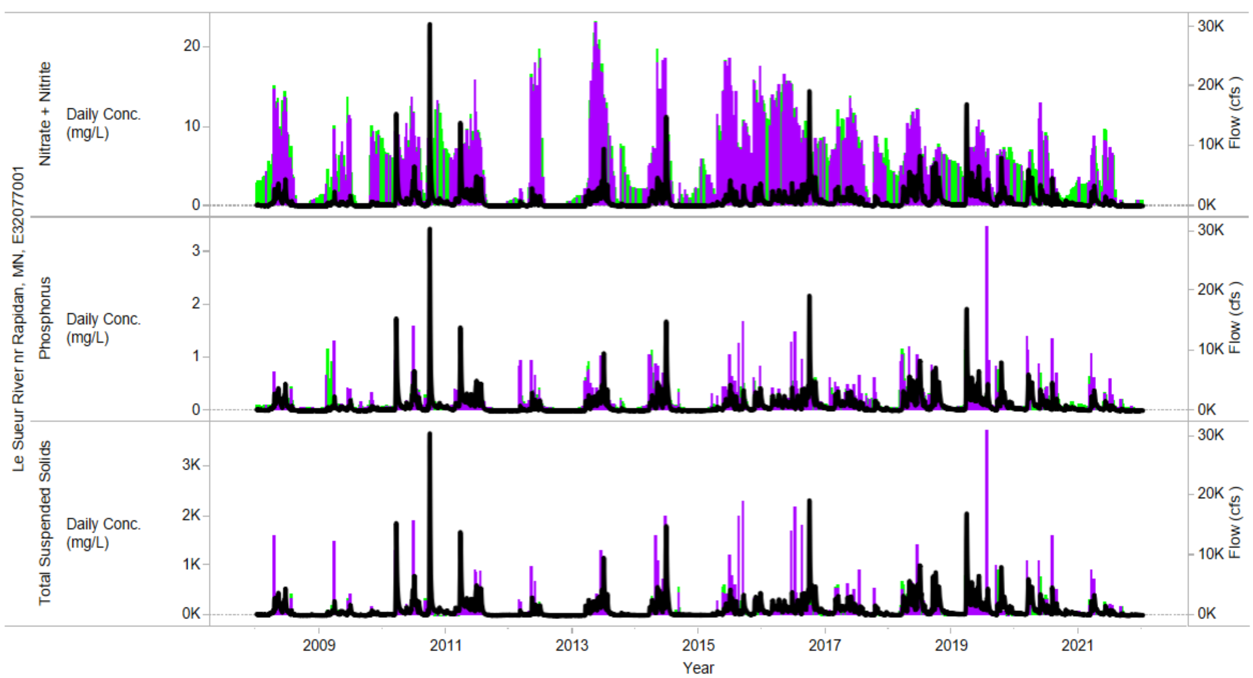
Continuous DO was collected at a rate of every 15 minutes from a sonde deployment in August 19 to 26, 2022 (Figure 45). Data shows daily DO concentration with a change of 5 mg/L, that correlates to normal flux. DO concentrations overall did not show much of a concern as they did not fall under 5 mg/L.

Figure 45. Continuous DO on WID -501 the outlet for the Le Sueur River Watershed.



Based on the data collected and reviewed during the Cycle 2 work, the biological communities within WID -501 seem to be improving. However, there is concern regarding elevated pollutants flowing out of the Le Sueur and downstream to the Blue Earth and Minnesota River, as shown in the hydrograph in Figure 46. As this is the outlet of the major watershed, there is a watershed pollutant load monitoring location that has tracked long term chemistry data. Out of al the parameters, nitrate shows to be of large concern with concentrations often rising above 10 mg/L throughout the summer months, TSS, and phosphorus are more erratic and often spike in response to rain events.

Figure 46. Graphs showing pollutant monitoring from 2008 -2021, at downstream portion of WID-501 (black shows hydrograph, purple is sample point, green is model output reference).



Limitations to data in Cycle 2 Lower Le Sueur River Subwatershed (nonassessed)

07020011-601 Unnamed Creek

WID -601 is a small, modified stream that was assessed as general use as it met the appropriate habitat conditions This stream is under a mile long and converges into the upper portion of the Le Sueur River (WID -507). There was one invertebrate sample at station 08MN059 in 2008 that determined the reach was not supporting aquatic life. The fish community was also found to be impaired after being sampled twice in 2008. Both visits scored below the general use threshold. Moderate changes in community structure were identified between the two 2008 samples due to replacement of sensitive ubiquitous taxa by tolerant and very tolerant taxa and individuals. Sensitive taxa and individuals are completely absent. Chemistry data indicates elevated nutrients could be a potential stressor to aquatic life. As there was not a biological sample for Cycle 2, this site is nonassessable for the SID update.

07020011-522 County Ditch 6

This is a small WID only sampled in Cycle 1 and directly below a Class 7 reach. The fish community passed, while macroinvertebrates fell just below the threshold. While this is a low priority site for SID, there was some chemistry indication of eutrophication.

07020011-506 Le Sueur River

WID -506 is a small section of the Le Sueur River that falls between WID -507 and the outlet of the Le Sueur River Watershed WID -501. This is also where the Maple River outlets into the Le Sueur River. This section of stream was only sampled once in Cycle 1 and was found to be passing for both fish and macroinvertebrates.

07020011-655 Silver Creek

Silver Creek, WID -655 has one monitoring station (08MN042). WID - 655 has only been sampled in Cycle 1 and was found to be impaired for fish and macroinvertebrates. This is the furthest upstream reach of this watershed that directly feeds into Iosco Creek. During the time of the biological sample in 2008, the taxa from both groups were found to be made up of generally tolerant taxa. Habitat was diminished due to channelization and nutrients were also found to be high. At the time of the fish sample, nitrate was at 13 mg/L. As there is not current data (within Cycle 2) it is difficult to assess the status, especially given the dramatic changes noted in Iosco Creek between the 10 years.

07020011-658 County Ditch 88

This is another small, modified use stream that is the receiving water for Rice Lake near St. Clair. There is a single station (08MN043) not reassessed for Cycle 2. In 2008 the invertebrate visit noted the flow limited stream habitat and lacked any flow dependent invertebrate taxa, such as clingers. There was one mayfly and no caddisflies. The limited taxa resulted in a macroinvertebrate impairment. The fish were also found to be impaired, as sensitive taxa were completely absent and the community was dominated by tolerant individuals (98%). Very tolerant fathead minnows made up over 50% of individuals collected.

Chemistry samples taken at the same time found high phosphorus (0.43 mg/L) and high TSS (150 mg/L). Ammonia was also slightly elevated compared to most other samples collected at the time at 0.1 mg/L.

07020011-661 Unnamed Creek

WID -661 is a modified stream that converges into the mainstem of the Le Sueur River. Biological assessment data from 2008 Cycle 1, was collected at station 08MN034. An attempt to sample for macroinvertebrates in August 2008 was unsuccessful as the stream was completely dry. The fish sample occurred a month prior (July 2008) and resulted in a fish IBI score of 24.5 out of 55. Western Blacknose Dace and Creek Chub were the only fish species collected. Nitrates were the only elevated pollutant collected during to fish sample, at 9.5 mg/L.

Little Cobb River (HUC-10 0702001102)

This report is a summary of findings. While some supporting evidence will be highlighted within the write up, most chemistry summaries and biologic metric scores will be found in the Appendix. Additional analytical data used in the assessment of these findings may also be available upon request. All biologic and chemistry findings can be found on the Water Quality Assessment Results Data Viewer. The term “Cycle 1” refers to the initial SID assessment from 2008 biological findings and “Cycle 2” is in reference to the current assessment from the 2018 biological findings. Figure 47 shows the streams and biological monitoring locations assessed for Cycle 2 in the Little Cobb River Subwatershed.

Figure 47. Little Cobb River (HUC-10 0702001102)

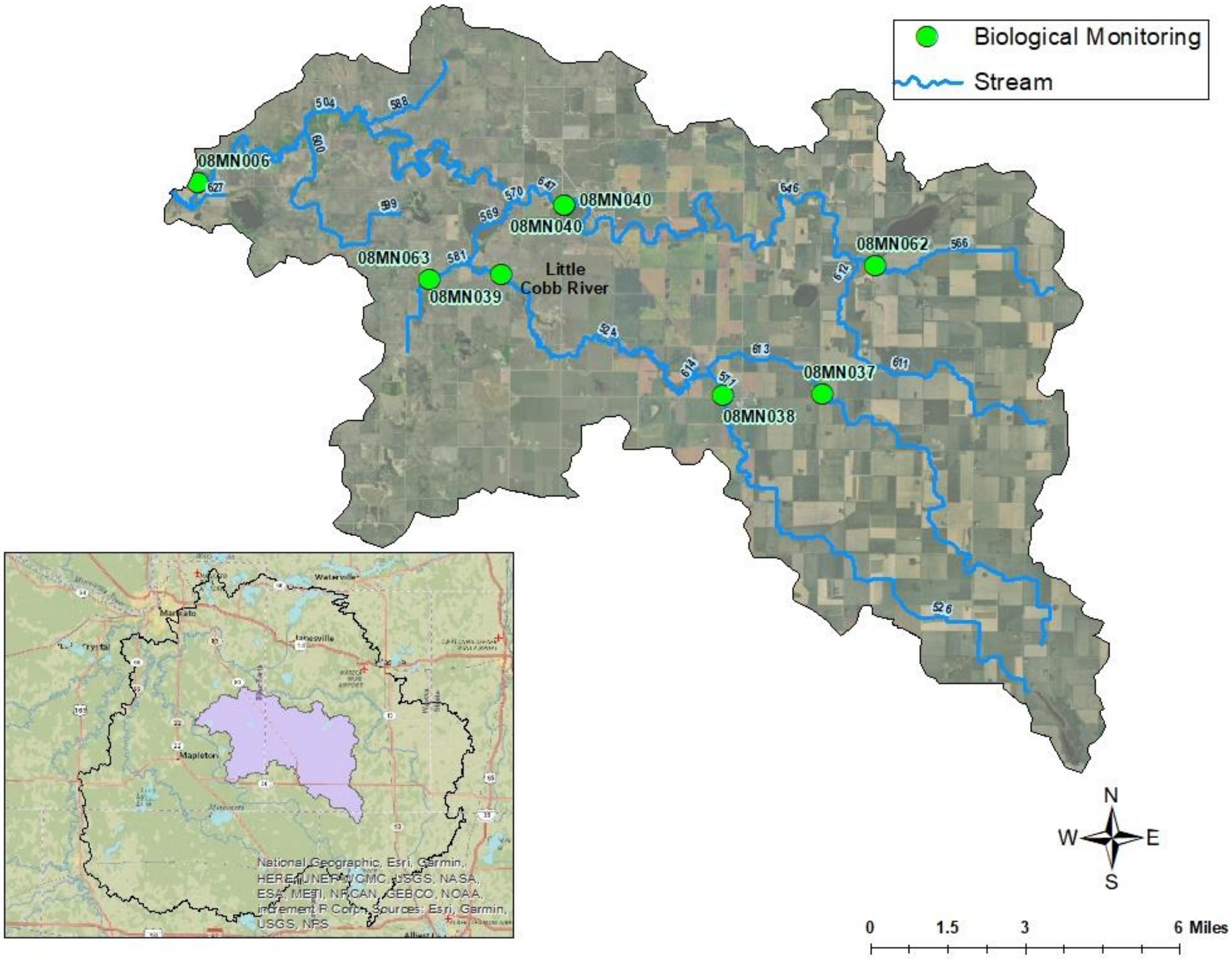


Table 8 is a summary of the assessed streams within the Little Cobb River Subwatershed and their relationship to stressors.

Table 8. Summary table of Cycle 2 SID assessment of the Little Cobb Watershed listed by WID.

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	**Stream Name**	**Biological Stations**	**Impairment**	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Little Cobb																					
524	County Ditch 8	08MN038 8MN039	F-IBI M-IBI	•		•		•	•		•	•			•	•	•		•	•	•	•
566	County Ditch 20	08MN062	F-IBI																		•	•
613	Unnamed Creek	08MN037	F-IBI								•				•	•	•	•	•	•		•
504	Little Cobb River	08MN006	F-IBI Inc	•	•		•		•		•			•								•
647	Bull Run Creek	08MN040 18MN010	F-IBI	•	•		•		•								•	•	•	•	•	•

Key	
	Inconclusive
	Stressor
	Not a stressor
•	Potential Driver

07020011-524 County Ditch 8

This stretch of the Little Cobb River, WID -524, has been assessed in multiple locations in both Cycle 1 and Cycle 2. The 08MN038 is the furthest upstream location with 08MN039 being the furthest downstream site on this nearly 16-mile length of stream. These locations can be seen in Figure 48, with clear changes in stream features from upstream to downstream. There is an artificial barrier between the two sites that could contribute to marginal species migration numbers (that will be discussed below). Trenton Lake is the headwaters for this ditch system. Looking at historical aerial imagery, this lake has frequent algal blooms in summer months (Figure 49). This lake was assessed in 2022 but data yielded insufficient findings for an impairment listing.

Figure 48. Taken at the time of biological monitoring, in order from upstream to downstream.

Figure 49. Aerial image of Trenton Lake on August 28, 2012; Google Earth Pro.

Fish and macroinvertebrate communities were found to be impaired across all locations. Within the fish community, in both 2008 and 2018, there was a complete lack of sensitive species present. The overall composition of the fish community did not change between the 10-year monitoring cycle. There was a lack of taxa diversity, and complete absence of sensitive species in any of the assessed samples. Outside the city of Waldorf is a man-made barrier that at times of moderate to low flow limits fish migration, as seen in Figure 50. For the macroinvertebrate community, the overall IBI scores slightly increased within the last 10 years, yet all fell well below the thresholds.

Figure 50. Fish barrier taken at the time of the July 18, 2018, fish sample.

Stressors to biology

Looking at tolerance values across all conventional parameters at WID -524, there are signals in nearly every fish and macroinvertebrate sample indicating broad impacts. As the fish and macroinvertebrates are primarily made up of generally tolerant species, there can be cross over indications when looking at the biological metrics alone. Some metrics did decline even further over time. Nitrate tolerance values within the fish community significantly declined in the last 10 years, more than any other metric category. Nitrate samples often fell within a high range. Nitrate is one of the primary stressors that is driven by altered hydrology from nearby agricultural practices. In addition, habitat scores (Figure 51) tend to show a decrease in quality over time. Particularly poor substrate diversity and channel instability are seen to displace riffle dwellers, lithophilic spawners, and benthic feeders within the fish community. Macroinvertebrates also did show a community made up of primarily high sediment tolerant taxa types. Habitat and TSS are both stressing the biology within this WID, with altered hydrology being the primary cause. The final stressor noted is connectivity for fish. While there are still some migratory species that are found upstream of the barrier, the overall count is low.

Figure 51. MSHA scores at WID -524 at 08MN038 and 08MN039.

Field Num	08MN038			08MN039	
Visit Date	7/15/08	7/18/18	8/8/18	7/16/08	8/6/19
Total Score	55.0	51.2	37.9	32.0	23.9
Ranking					

MSHA Legend

Poor Fair Good

0.0 100.0

Proposed Use Class	Use Class in Rule
2Bg	2Bg

Inconclusive or not a stressor

Chemistry values collected at the time of the biological samples show indication of eutrophic driven DO, noted in low saturation during early mornings and abnormally high in peak day time. However, there were eutrophic and low DO sensitive macroinvertebrates. In addition, there was little documentation to show an overabundance of algae or plant growth within this section, leaving both eutrophication and low DO as inconclusive.

07020011-566 County Ditch 20

County Ditch 20 (WID -566) is a small order stream that is a headwater to the Little Cobb River. This section was sampled in both Cycle 1 and Cycle 2 (Figure 52) for macroinvertebrates and in Cycle 2 for fish assemblage. The macroinvertebrate community was found to be fully supporting of the standard and had many pollutant sensitive species within the sample, indicating adequate water quality and habitat needs are being met in both cycles. In contrast, the fish sample in 2018 collected a single fish (bigmouth shiner) resulting in an impairment listing.

Figure 52. Conditions of County Ditch 20 taken at monitoring station 08MN062 on July 22, 2008 (left) and July 17, 2018 (right).

Stressors to biology

With only a single fish being found during the stream survey, and with an optimal macroinvertebrate community to indicate good water quality, fish barriers were looked at. A perched culvert that could impede fish migration is located downstream of the monitoring location, as shown in Figure 37 below.

Figure 37. Perched culvert causing fish impairments at 08MN062.

Other fish metrics were not able to be evaluated due to the single sample size. However, the macroinvertebrate community indicates a well-balanced community. It is feasible that if the barrier were corrected, the fish population would be thriving. There is some influence of altered hydrology that is noted in the slight incising of the stream that occurred between 2008 and 2018. This also is the driving force that has made the culvert lose its connectivity to the streambed.

07020011-613 Little Cobb River

WID -613 on the Little Cobb River is on a headwater tributary that runs parallel to the headwater section of WID-524. This stream passed for macroinvertebrate assemblage yet failed for fish both in Cycle 1 and in Cycle 2 at station 08MN037 (Figure 53). Creek chubs made up most of the population in both samples.

Figure 53. 08MN037 at the time of biological monitoring July 1, 2008 (left) and August 2, 2018 (right).

Habitat has significantly declined between Cycle 1 and Cycle 2 sampling, as shown within the MSHA scoring in Figure 54. Poor channel morphology and substrate are the limiting factors, with agricultural land use and channelization of the stream acting as the primary driver to habitat degradation.

Figure 54. MSHA score on WID -613 within the Little Cobb River.

Stressors to biology

Habitat and TSS seem to be the primary limitations for the fish community in WID -613. Looking at both fish and macroinvertebrate communities, TSS is found to be the largest stressor noted within the tolerance index of the communities. As TSS and eutrophication can impact similar communities, DO tolerance values were also looked at within both groups. DO did not seem to stand out as a clear stressor. Both habitat impairments and TSS stress is a direct result of altered hydrology from agriculture use.

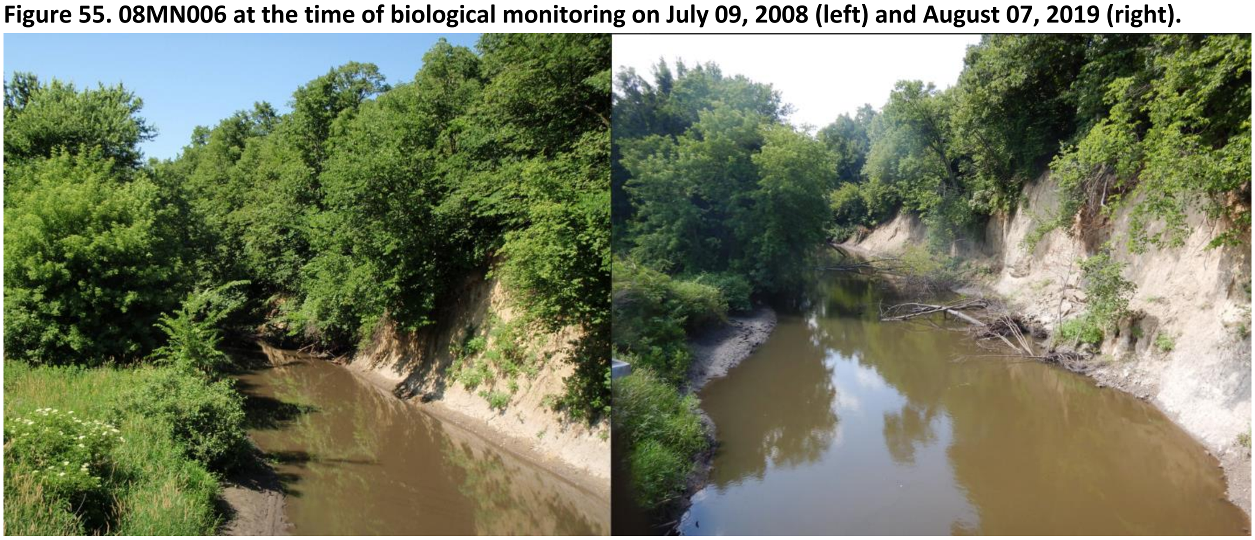
Inconclusive or not a stressor

Very few migratory species of fish were found in both Cycle 1 and Cycle 2 samples. However, there is not a known fish barrier that can account for connectivity as a stressor. Nitrate is another potential stressor as both fish samples had a lack of nitrate sensitive species. However, there was only one water chemistry sample for nitrate with a result of 9 mg/L at the time of the fish sample. Eutrophication and DO are ruled out as primary stressors, as both communities showed a good number of species that are sensitive to those parameters.

07020011-504 Little Cobb River

WID-504 of the Little Cobb River has an existing fish impairment based on Cycle 1 sampling at station 08MN006. SID from Cycle 1 determined that DO, eutrophication, nitrate, TSS, and habitat were all stressors driven by altered hydrology. This location was sampled again in 2019 for Cycle 2 (Figure 55).

Figure 55. 08MN006 at the time of biological monitoring on July 09, 2008 (left) and August 07, 2019 (right).



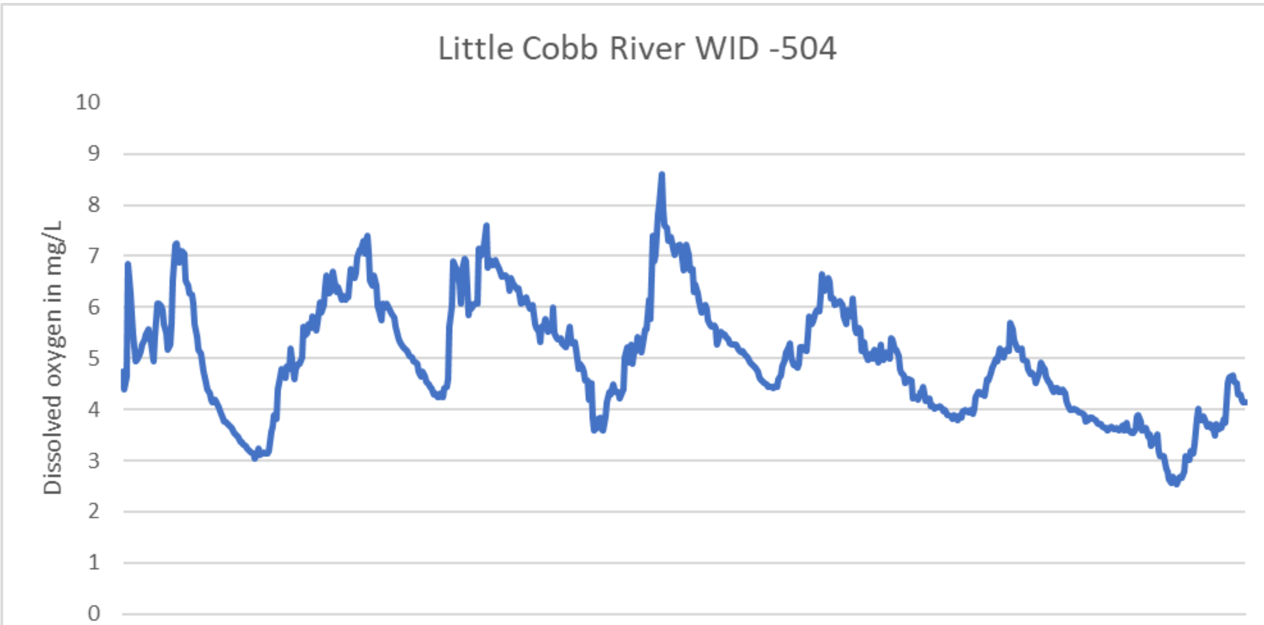
Between the original findings and the latest biological sample, the fish IBI increased from 30.3 to 42.9 yet still falls short of the threshold 50. Flows were noted to be of concern at the time of the biological sample. The species count from Cycle 2 was the same as Cycle 1, but the number of total fish was significantly lower in 2019 (514 vs 2,015). In 2008, fatheads were the most abundant species (1,165) and in 2019, spotfins were the most abundant (234). Cycle 2 assessment determined WID-504 was inconclusive as being able to be listed for a fish impairment. The macroinvertebrate community was found to be passing in 2018.

Stressors to Biology

This location does have an extensive dataset for chemistry, allowing for chemistry assessment to occur and list this stream impaired by nutrients, DO, and turbidity.

DO was collected following the latest biological sample, as shown in Figure 56. DO readings were collected every 15 minutes from August 29, 2022, to September 2022. The data shows clear indications that the DO impairment is ongoing as there were daily fluctuations below the 5 mg/L DO threshold.

Figure 56. Continuous DO readings from August 29, 2022 – September 09, 2022.



Low DO is likely being driven by eutrophication, as suspended algae were noted within the stream, as well as sediment oxygen demand as the stream bed was heavily embedded. As highlighted in the MSHA scores (Figure 57) substrate was one of the lowest scoring aspects of the stream. Silt and muck were at times knee deep.

Figure 57. MSHA scores at WID -504, July 9,2008, August 6, 2018, and August 7, 2018.

This is an area of the Little Cobb River where deposition is occurring. Base flow and flow in general are of concern in this WID. Site inspections at this location noted conditions observed in Figure 58 below, where water was often stagnant and not flowing.

Figure 58. Stagnant conditions in the Little Cobb River shortly downstream of WID -504 on September 7, 2022.

Inconclusive or not a stressor

WID -504 has a high amount of identified stressors to the fish community, with connectivity being the only inconclusive stressor. There are not any known physical barriers to account for the low migratory species. The poor flow conditions itself could be prohibiting some species to travel upstream.

07020011-647 Bull Run Creek

Bull Run Creek is a tributary within the Little Cobb River that has been designated a high priority in the Le Sueur River Watershed Comprehensive Watershed Management Plan (ISG 2023).

This section of Bull Run Creek (WID -647) has two stations (08MN040, 18MN010), each sampled once in 2018 (Figure 59). Station 08MN040 was also sampled in 2008 for Cycle 1 biological assessment. Biological sampling found that this section of Bull Run Creek does support the macroinvertebrate community, while the fish community was found to be impaired. The 2008 fish IBI scored 18.9 (well below the threshold of 35) resulting from only 13 species present and fathead minnows being the most abundant. The 2018 Cycle 2 sample scored 36.3, showing improvement. Eighteen species were found during the sample. Spotfin shiner, fathead minnow, and green sunfish were the most dominant species collected.

Station 18MN010 was placed slightly further upstream than 08MN040 and a newly established station for Cycle 2. This location scored a fish IBI of 45, significantly above the 35 threshold. Twenty-one species were collected during the sample.

Figure 59. Conditions of WID -647 on Bull Run Creek, taken at the time of biological sampling on July 23, 2008 (right) and August 7, 2018 (left).

Stressors to biology

Habitat and TSS are the leading stressors within Bull Run Creek. Figure 60 shows habitat displacement in nearly all scores aspects of the MSHA in every assessment.

Figure 60. MSHA at Bull Run Creek on WID -647, July 23, 2008, August 7, 2018, and August 14, 2018.

There are also clear indications of eutrophication occurring (Figure 61 and Figure 62) leading to TSS driven by both algae as well as sediment. DO stress could be the result of both eutrophication as well as sediment-oxygen demand. Continuous data collected from August 12 through August 19, 2022, shows DO flux that would be consistent with eutrophication, with low DO occurring mostly at night. Connectivity is also found to be a stressor at times of low flow at one of the culverts in this WID, as this culvert is slightly perched. Most times of the year, this is passable yet was observed to be above the base waterline on a few site visits.

Figure 61. Bull Run Creek DO flux at WID -647, August 12, 2022, through August 19, 2022.

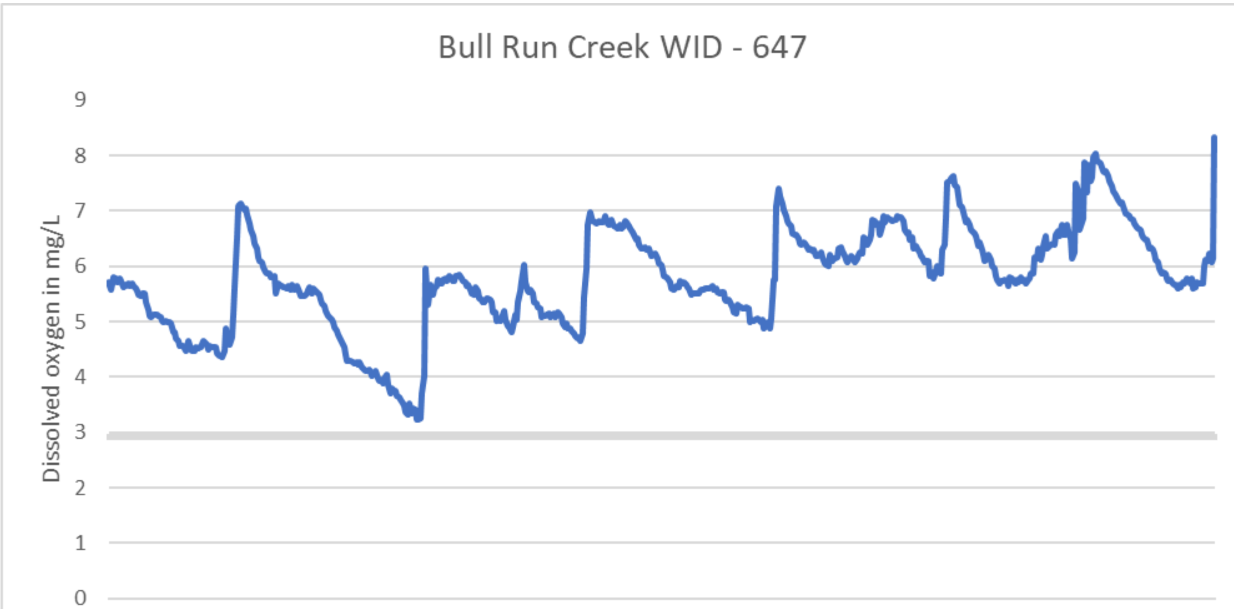
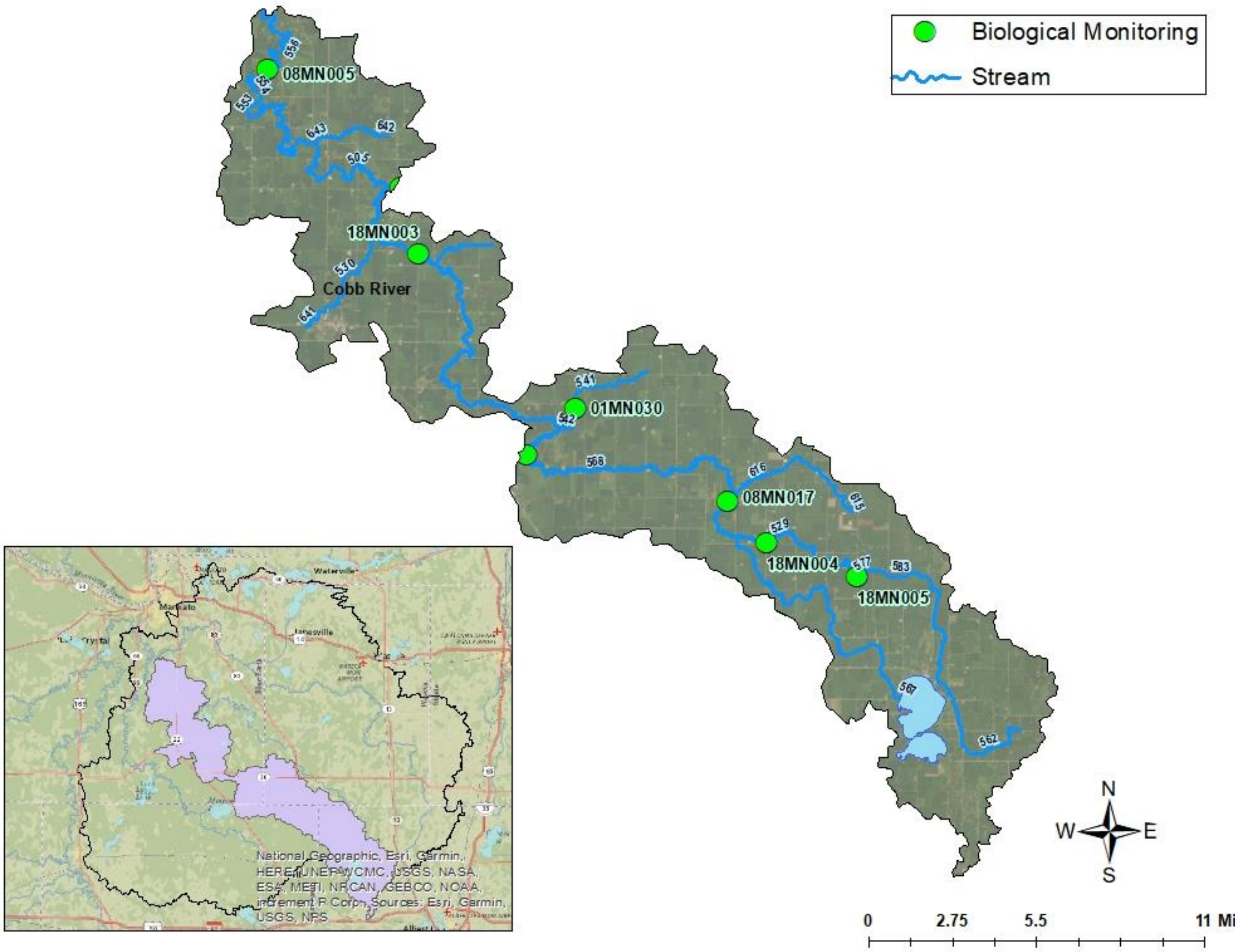


Figure 62. Bull Run Creek (WID -647) showing eutrophic conditions in algal growth.

Cobb River (HUC-10 0702001103)

This report is a summary of findings. While some supporting evidence will be highlighted within the write up, most chemistry summaries and biologic metric scores will be found in the Appendix. Additional analytical data used in the assessment of these findings may also be available upon request. All biologic and chemistry findings can be found on the [Water Quality Assessment Results Data Viewer](). The term "Cycle 1" refers to the initial SID assessment from 2008 biological findings and "Cycle 2" is in reference to the current assessment from the 2018 biological findings. Figure 63 shows the streams and biological monitoring locations assessed for Cycle 2 in the Cobb River Subwatershed.

Figure 63. Cobb River (HUC-10 0702001103)



The below Table 9 is a summary of the assessed streams within the Cobb River Subwatershed and their relationship to stressors. Sites that were not assessed for this Cycle 2 update are briefly addressed at the end of the section for this subwatershed.

Table 9. Summary table of Cycle 2 SID assessment of the Cobb Watershed listed by WID.

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	**Stream Name**	**Biological Stations**	**Impairment**	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Cobb River																					
568	Cobb River	08MN067 08MN071	F-IBI M-IBI	•					•		•			•				•	•	•		•
556	Cobb River	08MN005	F-IBI inc	•					•		•		•	•	•	•		•		•		•
541	Judicial Ditch 51	01MN030	Support																			

Key	
(blue)	Inconclusive
(pink)	Stressor
(hatched)	Not a stressor
•	Potential Driver

07020011-568 Cobb River

WID -568 is the furthest upstream and longest at a little over 53 miles in length within the Cobb River Subwatershed that was assessable for Cycle 2. During the Cycle 1 assessment, fish and macroinvertebrates were impaired due to altered hydrology driving habitat loss and high turbidity (TSS) (MPCA 2014). There were several stations assessed in both cycles, many that scored as poorly and similarly in both rounds. The one exception to this was at station 18MN011, that was a newly established site for fish, overlapping with station 18MN003 for invertebrates (Figure 64). These two stations were the furthest downstream point of the entire WID for the recent sampling period. While the macroinvertebrate community was severely diminished throughout all sections, the fish community in Cycle 2 showed improvement relative to Cycle 1 at the downstream location. Overall, this segment is still impaired for fish and macroinvertebrates as well as turbidity.

Figure 64. Furthest downstream station 08MN067 captured July 10, 2008, and 18MN011 on August 08, 2019, on the Cobb River.

Stressors to biology

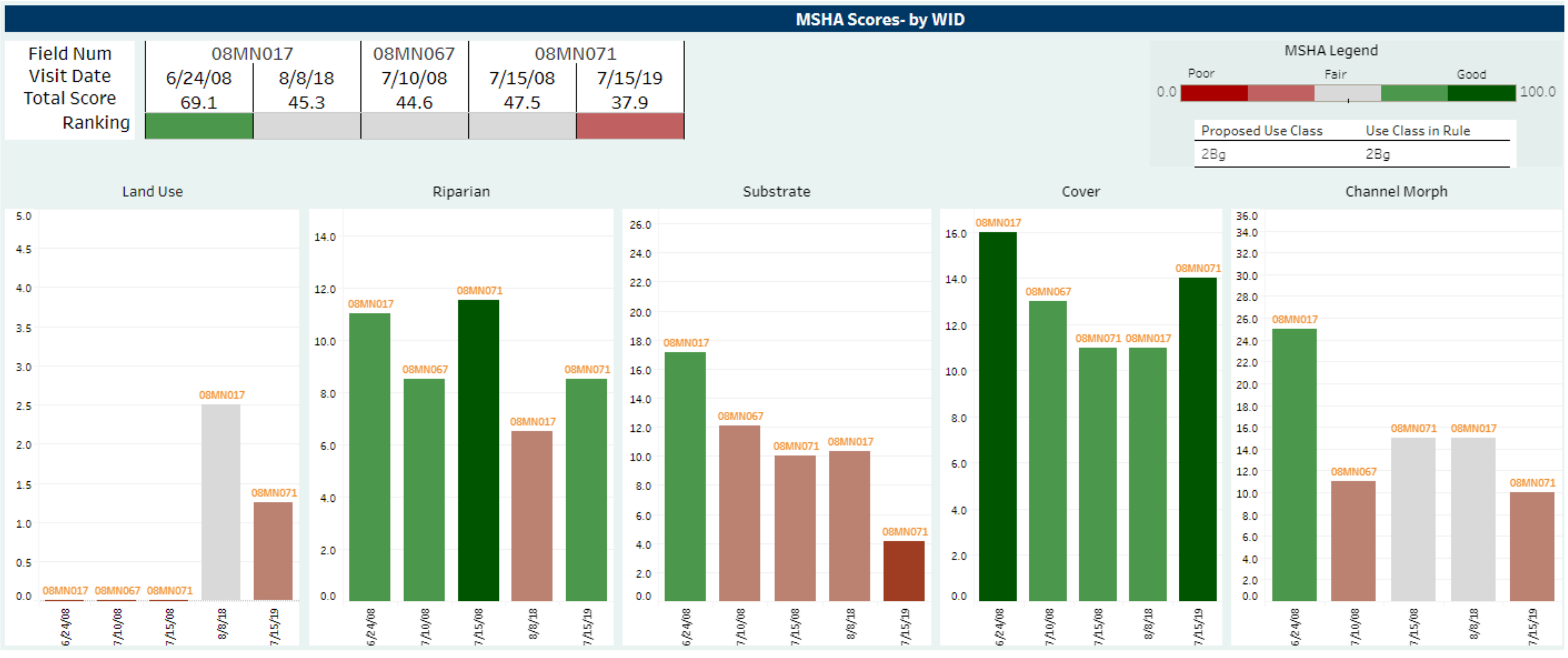
This section of stream has a mix of natural features and channelized stretches. Most land use within the reach watershed is agriculture. Between tile drainage and physical alterations of the stream, there have been dynamic stream changes as shown in Figure 65. The stream channel has changed significantly within the last 10 years, leading to mass channel erosion and loss of land. So much so, that this section has created cut offs of the old stream's pathway and created a new one. There is a current turbidity impairment that also coincides with the high erosion rates. Fish and macroinvertebrates also show consistent TSS stress with a lack of intolerant species, and an overabundance of TSS tolerant species. Across all parameters, TSS metric values indicated a clear stressor to aquatic life. Chemistry assessment also shows that 20% of TSS samples exceeded 65 mg/L with the highest in the last 10 years being 87 mg/L.

Figure 65. Upstream of WID – 568 capturing changes to stream and nearby land use. (Right shows erosion to pasture on the downside of culvert in 2017; middle highlights erosion up to the cornfield in 2018; left was captured at the time of the 2019 fish sample where the river formed a new channel).

This stream also declined in habitat between Cycle 1 and Cycle 2 (Figure 66), typical for areas with high erosion and turbidity. Between the two cycles there has been an increasing loss to overall habitat due to stream instability and loss of diversity within the streambed. Fish and macroinvertebrates did indicate species displacement from lack of available habitat. Macroinvertebrates that are tolerant to habitat needs seemed to increase in overall population, while fish species such as riffle dwellers and lithophilic spawners were in decline between the two cycles.

Nitrate is also thought to be playing a role in limiting biological communities. Across all years and communities sampled, nitrate sensitive species were consistently lacking. Nitrate had the most data collected out of all the other parameters (20 samples) yielding an average concentration of 8.75 mg/L.

Figure 66. MSHA scores at -568 that highlight stations that were scored in both cycles, between 2008, 2018, and 2019.



Inconclusive or not a stressor

DO did not seem to clearly limit the fish community in WID -568, nor were there exceptionally high or low DO values collected in the limited sample set. While the number of DO sensitive taxa were not prominent, there were some throughout the samples collected. Locations downstream seemed to score better compared to upstream stations. Similarly, this was noted within the macroinvertebrate communities sampled. Without continuous DO monitoring it is difficult to fully rule out DO as a stressor to aquatic life or as an indication to eutrophication, leaving both parameters as inconclusive as a stressor. There is a clear biological response in both fish and macroinvertebrates that is indicative to an algae dominant system, particularly upstream. Within the last 10 years there has been a shift in the macroinvertebrate community with the dominant feeder types of “gatherers” and “predators” shifting to “filter feeders” and “scrappers”. Chemistry also highlighted high phosphorus values, with half the collected samples falling above the standard of 0.15 mg/L. However, there are not any secondary chemistry responses noted that are needed to determine a eutrophic status. As with many streams that have headwaters prone to high nutrients and open canopy, it is plausible the algae within the water column are coming from upstream sources rather than developing within this section itself.

07020011-556 Cobb River

This section of the Cobb River is the outlet of the Cobb before it converges with the Le Sueur River mainstem. This WID is close to delisting its biological impairment, therefore is considered a priority location.

WID -566 on the Cobb River has one station (08MN005), sampled a total of three times, once in 2008, 2010, and 2018 (Figure 67). The 2018 sample scored just above the threshold at 50.1. Notable species collected in this sample were gar and large flathead. An additional fish collection in 2019 (nonreportable as a result of flows) sampled two shovelnose sturgeon and a short nose gar. While the newest score is above threshold, it did not meet statistically significant growth to place it out of fish impairment status. The macroinvertebrate samples throughout the years fall above and below the threshold, within the CI. Like the fish community, the macroinvertebrate community is not far off from reaching a supportive status.

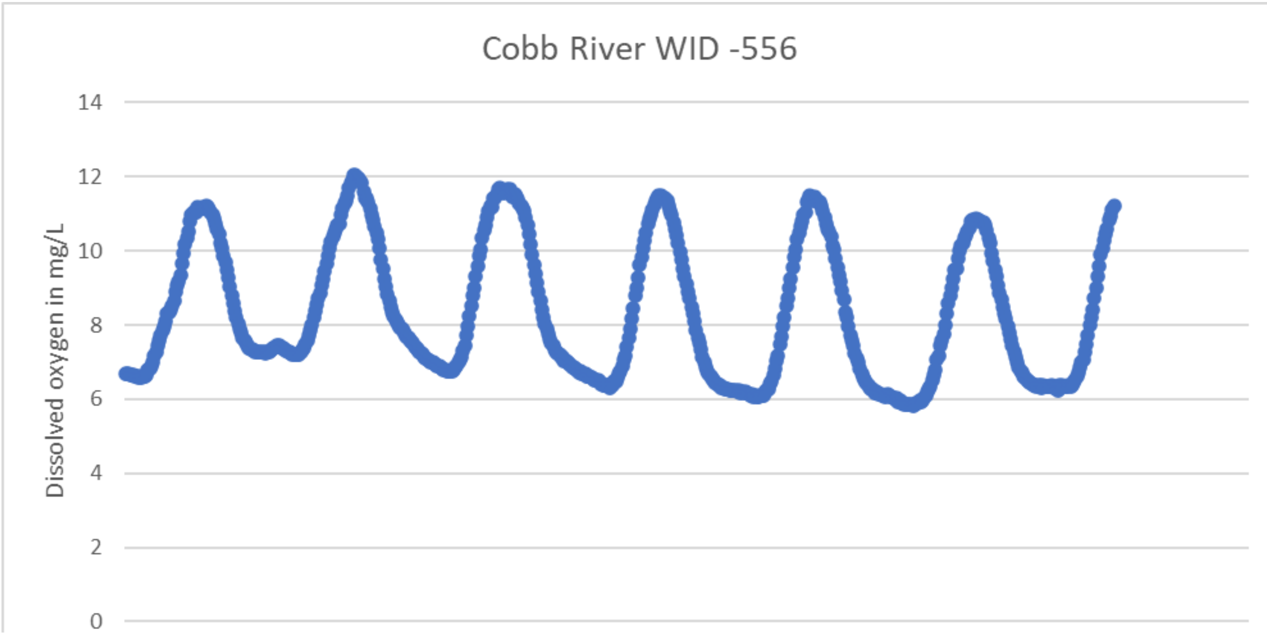
Figure 67. Conditions of Station 08MN005 at the time of biological monitoring on July 8, 2008 (right), August 24, 2010 (middle), and August 8, 2018 (left).

There are robust water chemistry datasets available within the assessment window at multiple stations across this reach of the Cobb River. Datasets are buoyed by regular watershed pollutant load monitoring at one upstream station (H32071001). In addition to the biologic impairment, this stream has a previous listing for aquatic life use based on turbidity (2008) and nutrients (2016). Extensive phosphorus data indicates elevated concentrations across the years. Chl-*a* data indicates a significant response to elevated nutrients and highlight eutrophication. Robust TSS and STUBE datasets reveal poor conditions for aquatic life. This can be noted in the stream's poor riparian scores as well as morphology (Figure 68).

Figure 68. MSHA scores at -556 of the Cobb River, July 2008, August 2010, and August 2018.

Continuous DO was collected every 15 minutes from August 19 through 26, 2022. Data (Figure 69) shows DO flux within a normal range being under 5 mg/L of daily swing. While DO came close to falling at or below the 5mg/L threshold, it was not recorded in this instance.

Figure 69. Continuous dissolved oxygen on the Cobb River at -556, August 19, 2022, through August 26, 2022.



07020011-541 Judicial Ditch 51

WID -541 has one station 01MN030 sampled in 2001 and 2018 (Figure 70). The designated use of WID -541 was previously changed to modified use, based on channelization and habitat characteristics. The WID was found to be in full support based on the modified use threshold for macroinvertebrates. The 2018 fish sample had a similar community as the previous Cycle 1 fish sample, aside from white suckers. In 2008 over 600 white suckers were collected, but in 2018 only 23 were collected. Regardless, there was sufficient diversity to determine this stream is not impaired for fish or macroinvertebrates.

Figure 70. Monitoring conditions at 01MN030 on July 23, 2008, (right) and August 01, 2018 (left).

This WID is slightly different in highlighting it as passing, as there are clear indications of stream instability Figure 71 that can create dramatic changes to habitat. In addition, there are WIDs upstream and downstream with biological impairments that were found in Cycle 2 assessments. Correlations to nearby land use or BMPs would be helpful to further investigate in understanding what practices are keeping biology from falling below the threshold between two WIDs that are not supporting biology.

Figure 71. Erosion along Judicial Ditch 51 on October 19, 2017.

Limitations to data in Cycle 2 Cobb River Subwatershed (nonassessed for SID)

07020011-530 County Ditch 57

In WID -530 fish and inverts were found to be impaired from Cycle 1 data. One invertebrate visit at one station (08MN066) was sampled in 2008. This sample was dominated by tolerant taxa and individuals. This WID has a proposed use class change (modified use) due to limited habitat. One visit from one station sampled in 2008 as part of Cycle 1 watershed monitoring scored below modified use threshold and below the CI. Nutrients are high (nitrogen and phosphorus) with abundant filamentous algae mats present. The fish community is hyper dominated by the very tolerant fathead minnow. WID -530 was determined to be nonsupporting of the modified aquatic life use based on fish assessment. There was not another biological sample completed in Cycle 2, therefore SID was not able to be done.

07020011-615 Headwaters to unnamed Creek

WID -615 is a small headwaters stream that flows into the mainstem of the Cobb River. While this branch was initially left out of Cycle 1 SID assessment, reevaluation of initial data found communities to be meeting the threshold developed for modified streams, for both fish and macroinvertebrates. This station was only sampled in 2008 at monitoring station 08MN068. While it is not often that both communities are found to be thriving in a channelized system, this section stands out as it has unique riparian vegetation that is allowing for slightly more habitat diversity (Figure 72).

Figure 72. Monitoring conditions of 08MN068 taken July 16, 2008.

07020011-505 Little Cobb River

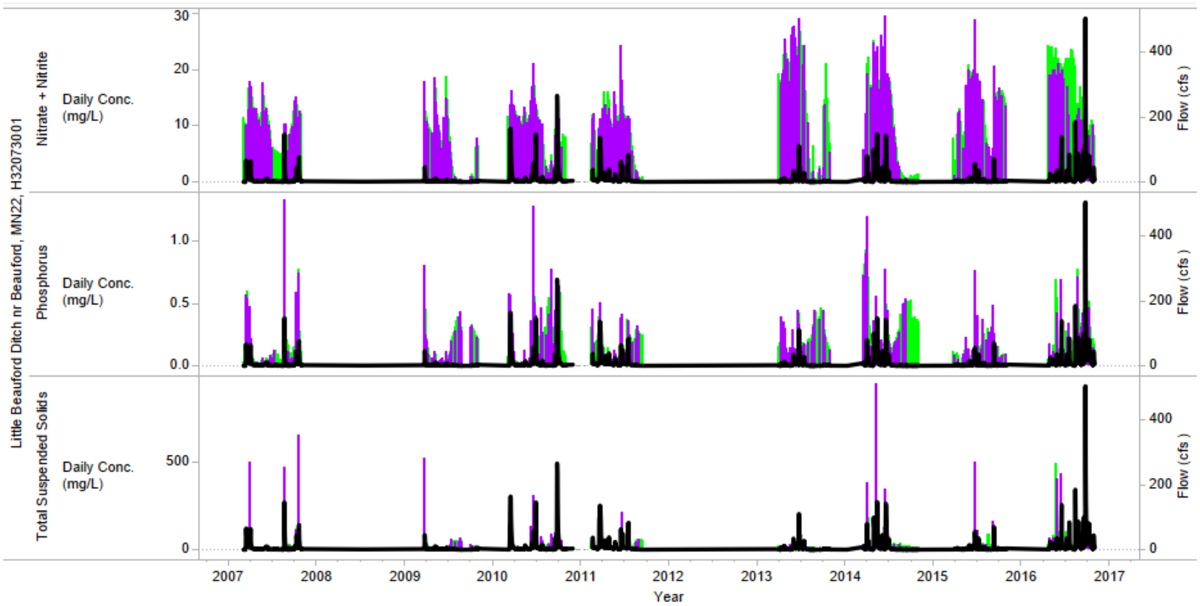
Modification to fish IBI affected scoring of sites at WID -505. In addition, further review of channel condition determined that both biological monitoring stations on this WID have a natural stream channel condition and the data should be assessed. One sample (2008) above threshold and C.I. and one sample (2001) below threshold and at lower C.I., indicating potential impairment. However, the lower scoring site (01MN039) was sampled again in 2010 as part of phase 2 work (this data was not yet available during assessment in spring 2010) and scored above threshold. With the recent data in 2008 and 2010 and preponderance of biological data (fish) indicates support for aquatic life. As this WID was not sampled for Cycle 2, there was little to be able to use for SID assessment.

07020011-642 Little Beauford Ditch

Despite Little Beauford Ditch (WID -642, being a high local priority, it was not possible to make a clear SID assessment for Cycle 2. This is due to the lack of current biological data collected in Cycle 2. However, there is a strong chemistry data set that does capture current water chemistry conditions, as there is a WPLMN station at the end of this WID (Figure 73).

There was only one macroinvertebrate visit at 08MN013, sampled in 2008. The sample scored less than one point below the modified use threshold. It is noted that there were very low water levels at the time of sampling. Another visit sampled in 2008 as part of Cycle 1 watershed monitoring also scored only two points below the modified use threshold. In addition to Cycle 1 biological sampling, there is an older station (91MN104) that was originally sampled in 1991 as part of the Minnesota River Assessment Project (MRAP) and scored below modified use threshold. It was sampled again in 2009 as part of a follow up MRAP study and scored right at modified use threshold. These visits are considered nonreportable because the sampling methodology is not consistent with standard operating protocol (SOP) but do provide additional data for consideration than at the time of Cycle 1.

Figure 73. Pollutant loading graphed in Little Beauford Ditch H32073001, 2007 through 2017. Black is the hydrograph, purple is sampled values, green is model output. Pollutants are shown on the y axis and time on the x axis.



More recent data (2008 and 2009 samples) suggest the stream is teetering near the threshold for support vs. nonsupport. Available macroinvertebrate data is also hovering right at the threshold. The sampling site is located roughly a half mile from the confluence with the Cobb River, a stream three orders larger. Therefore, the Cobb River has the potential to influence the fish community sample. As shown in Figure 73 there does seem to be an increasing trend in nutrient loading, particularly with nitrates. As fish and macroinvertebrates were technically found to be marginally passing in Cycle 1 there was not a second sample in Cycle 2. As this is the subject of many studies, it would be beneficial in the future to sample WID -642 to understand the biology in correlation to pollutant loading to help better establish benchmarks with biological communities.

07020011-530 County Ditch 57

Within WID -530, Station 08MN066 was sampled for Cycle 1 in 2008, resulting in a macroinvertebrate and fish impairment. Stressors were not addressed in the original SID report as metric thresholds for modified streams had not been developed. At the time of the macroinvertabrate sample, nutrients were high (nitrogen and phosphorus) with filamentous algae mats present. The fish community was primaraly made up of fathead minnows, which is a very tolerant species. As there was not additional sampling for Cycle 2, further SID was not be able to be conducted.

Maple River (HUC-10 0702001105)

This report is a summary of findings. While some supporting evidence will be highlighted within the write up, most chemistry summaries and biologic metric scores will be found in the Appendix. Additional analytical data used in the assessment of these findings may also be available upon request. All biologic and chemistry findings can be found on the [Water Quality Assessment Results Data Viewer](). The term "Cycle 1" refers to the initial SID assessment from 2008 biological findings and "Cycle 2" is in reference to the current assessment from the 2018 biological findings. Figure 74 shows the streams and biological monitoring locations assessed for Cycle 2 in Maple River Subwatershed.

Figure 74. Maple River (HUC-10 0702001105)

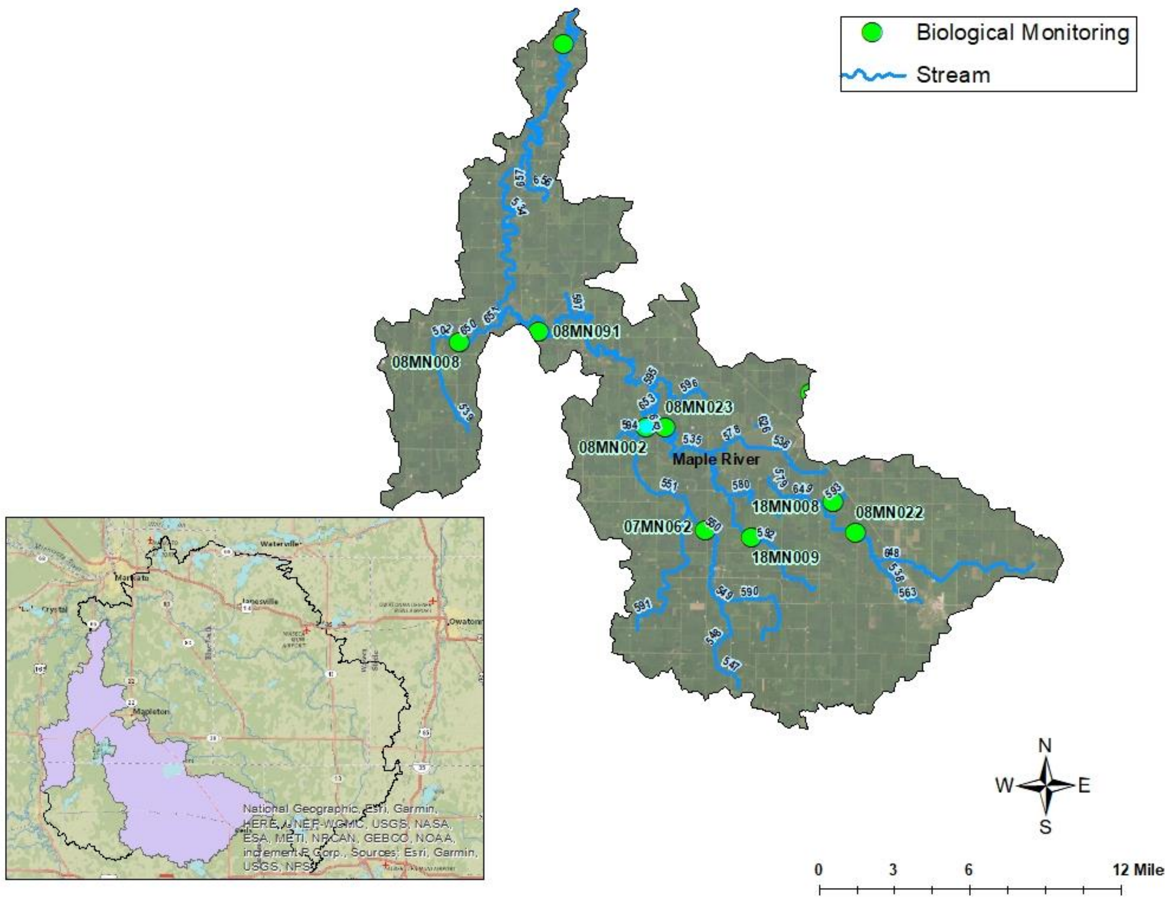


Table 10 is a summary of the assessed streams within the Maple River Subwatershed and their relationship to stressors. Sites that were not assessed for this Cycle 2 update are briefly addressed at the end of the section for this subwatershed.

Table 10. Summary table of Cycle 2 SID assessment of the Maple River Subwatershed, listed by WID.

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	**Stream Name**	**Biological Stations**	**Impairment**	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Maple River																					
593	County Ditch 85	08MN015 18MN008	F-IBI M-IBI								•				•	•	•		•	•		•
550	County Ditch 3	07MN062	F-IBI M-IBI								•			•	•	•	•	•				•
535	Maple River	08MN091 08MN023	F-IBI M-IBI	•				•				•		•	•	•			•	•		•
534	Maple River	08MN003 08MN019	Support																			
650	Providence Creek	08MN008	M-IBI*	•							•						•	•	•	•		•
652	County Ditch 7	08MN002	F-IBI M-IBI	•			•		•		•				•	•	•		•	•		•

Key	
	Inconclusive
	Stressor
	Not a stressor
•	Potential Driver

07020011-593 County Ditch 85

This headwater prairie stream (WID -593) has two stations: 08MN015 in Cycle 1 sampled in 2008, and 18MN008 for Cycle 2 sampled in 2018 (Figure 75) This stream was designated as modified use based on channelization and habitat characteristics upstream from the confluence of Minnesota Lake. Macroinvertebrates and fish were found to be impaired. Macroinvertebrates found were categorized as tolerant or very tolerant. In the most recent fish assessment, the sample was dominated by 318 fathead minnows with the next most abundant species being 51 johnny darters.

Figure 75. Conditions at the time of monitoring at 08MN015 on July 26, 2008 (right) and 18MN008 on August 01, 2018 (left).

Stressors to biology

Habitat is a clear stressor to biology within WID -593. As shown in Figure 75, both site visits show an extremely entrenched and ditched channel. While the MSHA score for substrate scored fair (Figure 76), this section of stream is primarily silt, sand, and clay. Primarily generalist and tolerant species made up both macroinvertebrate and fish samples, indicating a lack of specialized habitat. Altered hydrology is the driving force of the entrenched channel in this case.

Figure 76. MSHA scores in County Ditch 85 in WID -593.

Inconclusive or not a stressor

At the time of the fish sample in 2008, nitrates were elevated at 14 mg/L. At the time of the fish sample in 2018, nitrate concentration was found to be 8.6 mg/L. Additional chemistry monitoring is lacking at this location. As there is a lack of species diversity within the biological samples at these locations, it is difficult to use biological metrics to highlight specific pollutant stressors as limiting factors. For this reason, all other conventional stressors are listed as inconclusive. In the 2018 sample there were a few migratory species found, therefore connectivity is ruled out as a stressor.

07020011-550 County Ditch 3

County Ditch 3 (WID -550) is a small tributary upstream of the Maple River. This section is impaired for both fish and macroinvertebrates with a single monitoring station of 07MN062 (Figure 77). There was little change between the macroinvertebrate communities sampled in 2008 and 2018. The 2008 invert IBI scored 23.2, and the 2018 sample scored 25.1. The fish IBI from Cycle 1 (2008) was determined to be nonreportable due to high flow. The 2018 sample had higher numbers of fish and more species compared to the 2008 sample. However, the overall IBI score remained low. In addition to the biological impairment, this WID has limited chemistry assessment work, or additional samples taken.

Figure 77. Conditions at the time of monitoring 07MN062 taken July 22, 2008 (right) and July 31, 2018 (middle and left).

Physically, not a lot has changed within the channel of this WID. As shown in Figure 78 below, the greatest threats to the stream's habitat is land use as well as the riparian area's lack of cover and vegetation. This is a channelized stream.

Figure 78. MSHA score on County Ditch 3 at WID -550, August 2007 and July 2018.

Stressors to biology

While there does seem to be enough diversity in stream habitat to support the macroinvertebrate community, the poor channel stability is allowing for erosion to cause excess TSS to go through the system. Both inverts and fish communities did show a negative response in TSS metrics.

There were only a couple of water quality samples taken for conventional parameters, with nitrates being the only value of concern at 10 mg/L. Species sensitive to nitrates within the macroinvertebrate community were completely missing in the 2018 sample. In both cycles the sample was dominated by nitrate tolerant species. Nitrate is considered a stressor to biology within WID -550.

Inconclusive or not a stressor

Eutrophication and low DO are not primary stressors within either community, especially as macroinvertebrates showed the highest supporting scores related to low DO. Migratory species within this reach are greatly lacking, yet there is not a known barrier downstream, leaving connectivity inconclusive as a stressor.

07020011-535 Maple River

This is one of the longer assessed WIDs of the Maple River, located downstream of Minnesota Lake. The farthest upstream station is 08MN023 (Figure 79) where biology scored poorly in both Cycle 1 and Cyle 2, while the furthest downstream station of 08MN091 (Figure 80) showed less of an impairment, with macroinvertebrates scoring well above the threshold in later years. As shown below, the 2013 sample was taken when eutrophic conditions were present, where other years of 2022 and 2023 highlight why this stream is impaired by turbidity.

Figure 79. Conditions at the time of biological monitoring at 08MN023 on July 24, 2008 (left), and August 06, 2019 (right).

Figure 80. Conditions at the time of biological monitoring at 08MN091 August 21, 2013 (right), August 24, 2022 (middle), August 21, 2023 (left).

The fish community did show some improvement between Cycle 1 and Cycle 2 at the furthest downstream station, with the most recent sample at 08MN091 scoring significantly above the threshold. It is worth noting that the next downstream WID is not impaired for fish, confirming that this downstream section supports a more diverse fish community than the upstream section. However, even the upstream station of 08MN023 showed some improvement in the fish community in Cycle 2, yet still failed to meet the expected threshold.

Stressors to biology

This section of the Maple River (WID -535) has a turbidity impairment, that is reflected in the data as well. Macroinvertebrates showed the strongest signal of being stressed by TSS. Often with a TSS stressor to biology, habitat is found to be degraded as well. As shown in Figure 81 below, overall scores show fair habitat. However, there were signals within the fish community of habitat displacement for benthic spawners and riffle dwellers. There was also a decrease of riffle dwellers at the upstream station. Macroinvertebrates also showed some imbalance in terms of functional feeding groups and expected habitat types. There is a lot of variability between location and time, yet the furthest upstream sections conclude that habitat is limiting biology within WID -535.

Figure 81. MSHA scores during multiple site visits within WID -535 of the Maple River.

Inconclusive or not a stressor

Monitoring of WID -535 often found nitrate values just below 10 mg/L. Across all samples, there seems to be a slight improvement over time and moving from the upstream site to downstream site. It is possible nitrate impacts are either improving or mitigated by the lake's ability to denitrify what is in the stream column. Nitrates as a stressor are inconclusive at this time but should be reevaluated in the future. There is also some evidence of eutrophication occurring, noted in both biology, chemistry, and visual conditions, yet there are not enough secondary responses to determine if it is a stressor. By extension, DO is also inconclusive. There do not appear to be any barriers limiting migration meaning connectivity is not a stressor.

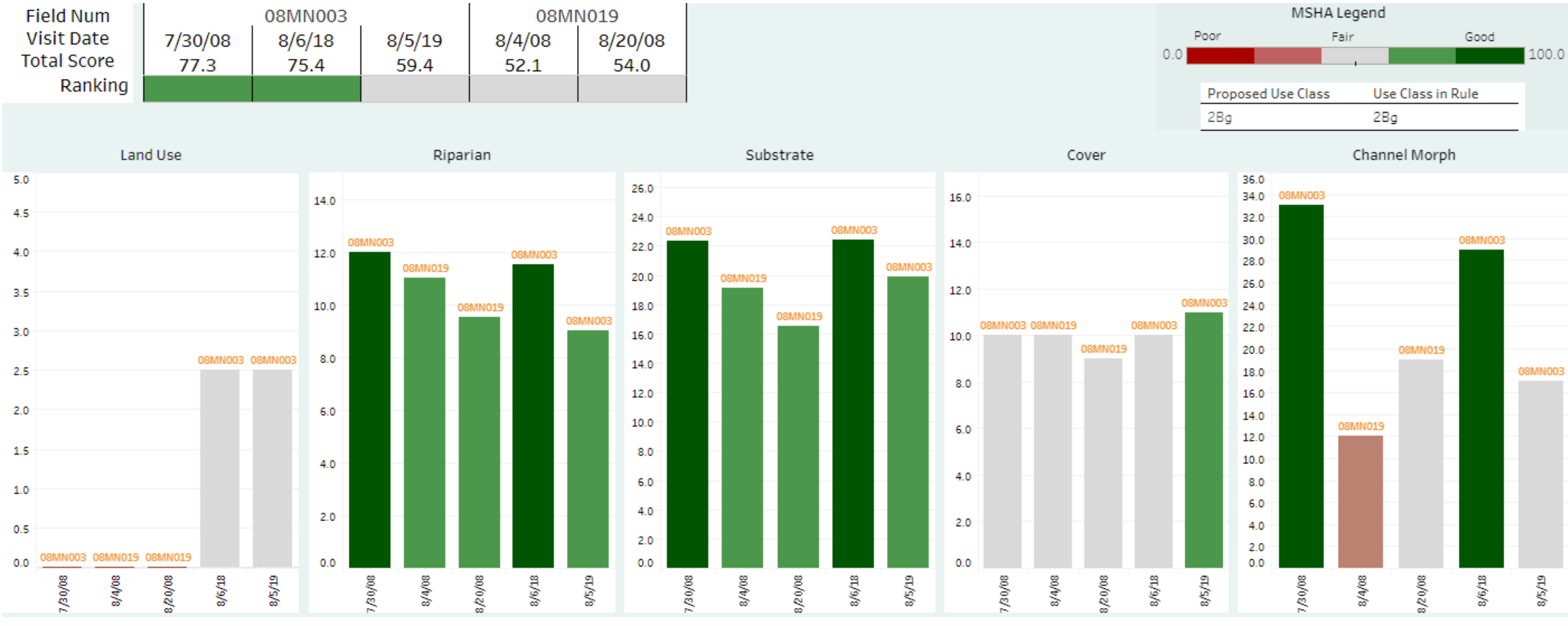
07020011-534 Maple River

This WID (-534) of the Maple River has two stations (08MN003, 08MN019) sampled a total of three times, twice in 2008, and once in 2018. Data from current assessment (2018) suggests a nonimpaired conditions as data from 08MN003 scored significantly above the threshold. The invertebrate community is excellent, with three intolerant taxa present, and abundant clinger and Ephemeroptera, Plecoptera, Trichoptera (EPT) diversity.

Figure 82. Monitoring station 08MN003 on July 30, 2008 (right) and 08MN019 on August 20, 2008 (left).

Exceptional habitat conditions at 08MN003 are noted below in Figure 83 over multiple MSHA assessments.

Figure 83. MSHA scores in the Maple River at WID – 534.



Most data in both assessment cycles suggest a full-support condition. It was recommended that WID -534 be changed to full support of aquatic life based on macroinvertebrate data after Cycle 2 assessment. There is not an existing fish impairment on this WID. While the upstream WID (-535) is impaired for fish, there is an improving trend from upstream to downstream, particularly over time. The fish communities were consistent in their composition between the first and second sample, suggesting the stream has not changed.

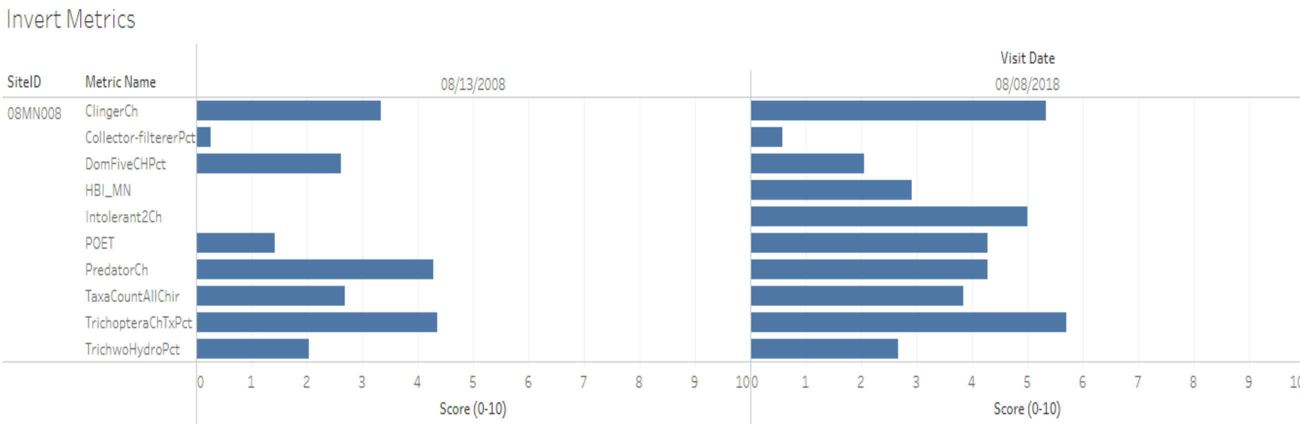
07020011-650 Providence Creek

Providence Creek (WID -650) is a modified use stream due to channelization and outlets into WID-534. This is one of the few sites that improved between Cycle 1 and Cycle 2 regarding the fish community. The previous fish impairment has been removed as the reach is now found to be in support. Station 08MN008 was sampled for Cycle 1 in 2008 and again for Cycle 2 in 2018 (Figure 84) that resulted in a current impairment for the macroinvertebrate community. While the reach is technically impaired for macroinvertebrates, the IBI values fell near the threshold. Nearly/barely streams like this stand out during assessment, as fewer practices are needed to result in a support of aquatic life.

Figure 84. Monitoring station 08MN008 at the time of sample on June 25, 2008 (right) and July 31, 2018 (left).

In 2008, the M-IBI score was 21 and in 2018 it was 36.7 with the threshold being 41. Figure 85 highlights the composition of the community that makes up the overall score. Between the two sampling years, there was an increase in taxon types and sensitive species.

Figure 85. Macroinvertebrate metrics within Providence Creek.



Stressors to biology

Habitat is one of the clear limitations to the macroinvertebrate community (Figure 86). While cover is rated as good, the primary source of habitat for macroinvertebrates was noted to be overhanging vegetation and aquatic macrophytes (algal mats). The substrate and overall stream stability is playing a limiting factor. This section is rated as being moderately embedded. As this stream has been altered by way of channelization for agriculture, altered hydrology is the primary driver to creating stream instability and poor habitat features.

Figure 86. MSHA scores within Providence Creek WID -650, June 2008, July 2018, and August 2018.

Inconclusive or not a stressor

It is likely that WID -650 is eutrophic. Algae was noted in the 2018 sample (Figure 87). While chemistry samples are limited to what was collected at the time of the sample, there was one early morning reading of DO of 5.84mg/L and only 66% saturation. This would be indicative of a eutrophic stream coming out of a period of respiration. While phosphorus fell below 0.15 mg/L, nitrates were elevated at 12 mg/L. The macroinvertebrate metrics did indicate a lack of nitrate sensitive species within the sample, yet still had some nitrate sensitive taxon present. It is likely an effort to reduce nutrient inputs and stabilize the habitat would result in this impairment being delisted in time.

Figure 87. Aquatic vegetation at the time of 2018 sample at 08MN008.

07020011-652 County Ditch 7

This section (WID -652) of County Ditch 7 is downstream of WID -591 that was found to be passing in Cycle 1. This is a modified stream due to channelization and is impaired for both fish and macroinvertebrates. One station (08MN002) was sampled in 2008 for Cycle 1 and 2018 for Cycle 2. In 2018, water levels were low and there was not adequate habitat to support collection of an invertebrate sample. It was determined that this was an unnatural condition, and the site was given an IBI score of 0. Despite a lack of data, this score looks very similar to what was found in 2008 (Figure 88), as this site received a score of 1.4. The fish sample from 2008 scored only 21.7, which is below the modified use threshold of 35. The 2018 score was similar at 22.5. Only 16 species were collected with fathead minnows being the most abundant (223 individuals), and common shiner was the next most abundant (85 individuals). As macroinvertebrates were sparse, metrics will not be of use for that community. In addition to the Aquatic Life impairment, WID -652 also has a turbidity impairment.

Figure 88. Monitoring conditions at 08MN002 on July 29, 2008 (right) and July 16, 2018 (left).

Stressors to biology

Habitat in WID -652 is the clearest limitation to biology, as it's altered conditions were the reason the second macroinvertebrate sample could not be conducted. The MSHA assessment (Figure 89) highlights the reach's poor habitat diversity and stream stability. The fish community was dominated by generally tolerant species that do not have specific habitat needs for their life cycle needs, noted in the lack of benthic insectivores, lithophilic spawners, and nest guarders. These are the same groups that would typically be displaced by TSS or turbidity. Nitrate was a parameter that was high at the time of sampling (12 mg/L). There were 13 additional samples collected for nitrates that often exceeded 10 mg/L with the highest reaching 15 mg/L. Fish metrics did indicate some nitrate displacement within the tolerance values. There was also a deformity within the 2018 sample that can be associated with high nitrate environments.

Figure 89. MSHA of County Ditch 7 on WID -652, July 2008 and July 2018.

Inconclusive or not a stressor

While the fish community in both samples were generally tolerant, there was enough variability to give some level of tolerance values. Outside of habitat, TSS, and nitrate tolerance values there were not clear indications noted within the other parameters (DO, eutrophication). However, there is some indication within the chemistry data as there were a few lower DO readings, yet not enough to tell if it was the result of eutrophication and DO flux. Phosphorus values were mixed with the highest value at 0.21 mg/L. Eutrophication and DO are listed as inconclusive. Migratory species were present in the sample ruling out connectivity as a stressor.

Limitations to data in Cycle 2 Maple River Subwatershed (nonassessed for SID)

07020011-592 County Ditch 7

This is the furthest upstream headwater tributary (WID -592) that leads to the Maple River, prior to the confluence of Minnesota Lake. This site has two stations: 08MN014 sampled in 2008 for Cycle 1, and 18MN009 in 2018 for Cycle 2 (Figure 90) Cycle 1 macroinvertebrates were found to be in support while the fish community was impaired. In Cycle 2, 18MN009 was a new site within WID -592. The biological sample at 18MN009 showed a greatly improved fish community. However, it was determined that the old station of 08MN014 should be sampled to ensure the delisting of the biological impairment within this WID. The status for the biological impairment is currently inconclusive for fish, therefore SID was not completed.

Figure 90. Conditions at the time of monitoring 08MN14 on June 25, 2008 (right) and 18MN009 on August 01, 2018.

07020011-590 County Ditch 20

This stream (WID -590) was not assessed in Cycle 2. While there were other modified streams that passed during Cycle 1, this station stands out as the IBI score rose above most others. One invertebrate visit at one station (08MN045) was sampled in 2008 (Figure 91). This reach also has a proposed use class change to modified use, due to channelization and limited habitat. The sample scored above the modified use threshold, above the 90% confidence limit and was determined to be in full support of the modified aquatic life use, based on the invertebrate assessment. In 2008, there were two fish visits on 08MN045 as part of Cycle 1 watershed monitoring. Both visits scored significantly above the modified use threshold and the upper CI. Additional habitat assessment and community composition determined that ecosystem function is largely maintained. There was not a second sample in Cycle 2, as this location clearly passed in Cycle 1. This stream is modified by way of channelization. However, there is enough diversity noted in the riparian area, vegetation, and meandering of the stream that is likely allowing species to thrive at this location.

Figure 91. Conditions highlighting habitat in 08MN045 at the time of biological monitoring on August 12, 2008.

07020011-550 County Ditch 3

Two invertebrate collections were made at station 07MN062 in 2008 during Cycle 1, located in WID -550). These scores contradicted each other as one sample scored well above both the modified use and even the higher general use threshold; the other sample collected at the same location scored below the modified use threshold. It was determined that the status would default to the higher score, which represents the best attainable condition for the year of record. Therefore, this site was given status of full support of the modified aquatic life use, based on the invertebrate assessment. However, the fish data was nonassessable.

07020011-591 County Ditch 7

Macroinvertebrates were found to be passing in Cycle 1 based on a visit at station 08MN012 sampled in 2008. WID -591 is classified as modified use, due to limited habitat from channelization. The fish also scored above modified use threshold and the upper CI. There was not another biological sample collected for Cycle 2.

07020011-596 Big Slough

Macroinvertebrates were found to be passing in Cycle 1 based on a visit at station 08MN041 sampled in 2008 (WID -596). This WID is classified as modified use, due to limited habitat from channelization. The fish also scored above the modified use threshold and the upper CI. There were not biological samples collected for Cycle 2.

07020011-548 Unnamed Creek

WID -548 was found to be impaired for macroinvertebrates in Cycle 1. There is limited current data, therefore it is unable to be properly investigated in the SID process in Cycle 2. In Cycle 1, the single invertebrate sample was collected at station 08MN044 in 2008. The sample scored below the modified use threshold. The sample was dominated by tolerant taxa, and only three EPT taxa. Very high nitrogen levels were documented at the time of fish sampling, which could be related to invertebrate community impacts. The fish community scored significantly above the threshold in 2008 for the Cycle 1 assessment. There were not biological samples collected for Cycle 2.

07020011-656 Unnamed Creek

One invertebrate visit was completed at one station (08MN043) in 2008 in WID -656 The sample scored below the modified use threshold, within the 90% confidence limit. WID -656 is a flow limited stream, lacking any flow dependent invertebrate taxa. No mayflies or caddisflies were present. One fish sample was completed from one station sampled in 2008 as part of Cycle 1. Fish IBI scores were below the modified use threshold and below the 90% CI. Sensitive taxa were completely absent, and the community was dominated by tolerant taxa and individuals. As there was not a follow up sample in Cycle 2, and limited chemistry data due to the location and size of this small headwater, this WID is not able to be investigated for SID.

Rice Creek (HUC-10 0702001104)

This report is a summary of findings. While some supporting evidence will be highlighted within the write up, most chemistry summaries and biologic metric scores will be found in the Appendix. Additional analytical data used in the assessment of these findings may also be available upon request. All biologic and chemistry findings can be found on the Water Quality Assessment Results Data Viewer. The term “Cycle 1” refers to the initial SID assessment from 2008 biological findings and “Cycle 2” is in reference to the current assessment from the 2018 biological findings. Figure 92 shows the streams and biological monitoring locations assessed for Cycle 2 in the Rice Creek Subwatershed

The Rice Creek Watershed is considered a high priority area based on significance of stream size, historical monitoring efforts, and local partner interest as documented in the Le Sueur 1W1P (ISG 2023). There are two lakes that feed into Rice Creek, those being Rice Lake and impaired Lura Lake. There were only two WID’s assessable for Cycle 2 SID identification for biological impairments in the Rice Creek Subwatershed.

Figure 92. Rice Creek (HUC-10 0702001104)

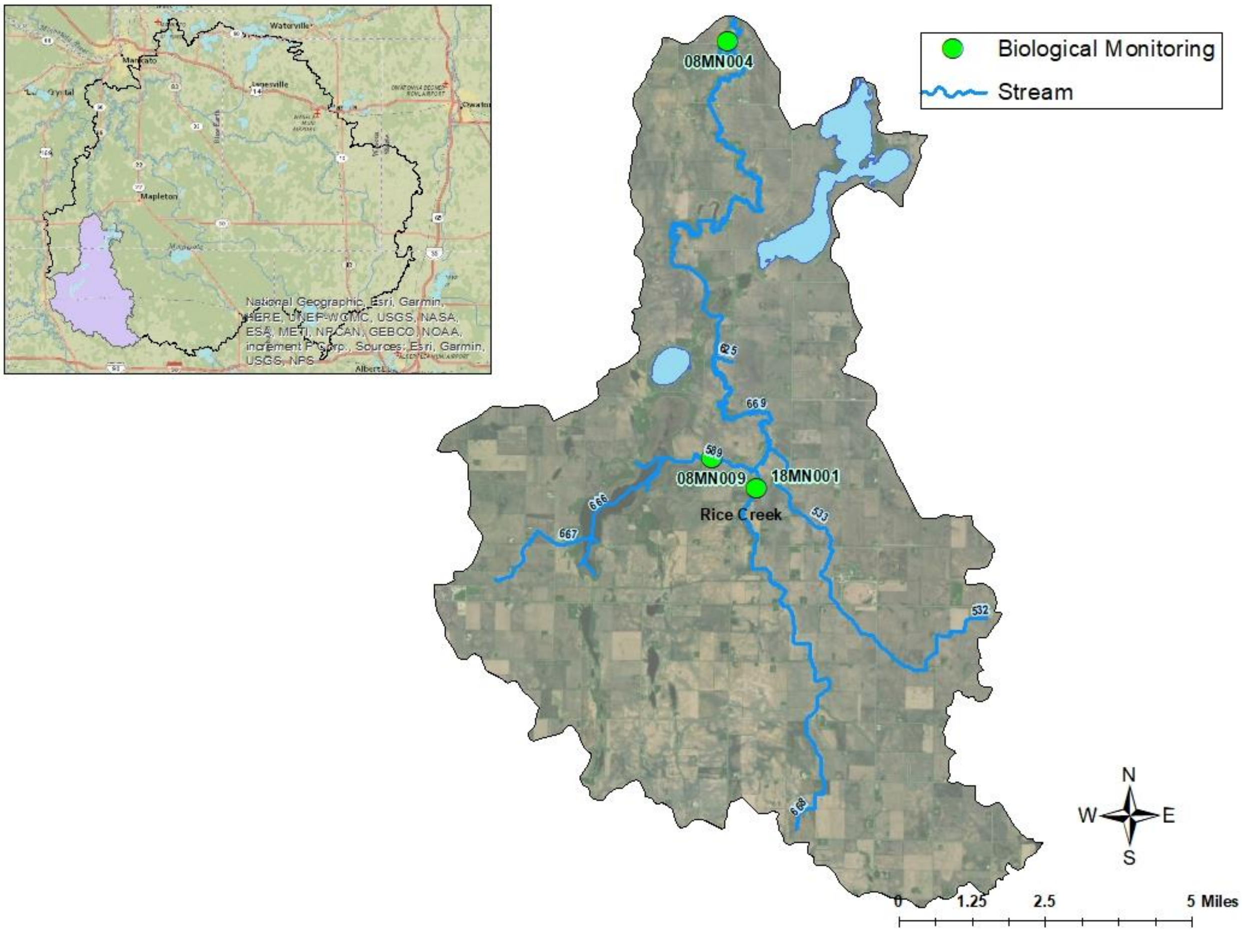


Table 11 is a summary of the assessed streams within the Rice Creek Subwatershed and their relationship to stressors.

Table 11. Summary table of Cycle 2 SID assessment of the Maple River Subwatershed, listed by WID.

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	**Stream Name**	**Biological Stations**	**Impairment**	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Rice Creek																					
589	Unnamed Creek	08MN009	F-IBI M-IBI	• Stressor	Stressor	• Stressor	Stressor	• Stressor	• Stressor	Stressor	• Stressor	Stressor	Stressor	• Inconclusive	• Inconclusive	Inconclusive	• Stressor	• Stressor	• Stressor	• Stressor	Not a stressor	• Stressor
669	Rice Creek	08MN004	M-IBI	• Inconclusive	Inconclusive	• Inconclusive	Inconclusive	Inconclusive	• Inconclusive	Inconclusive	• Stressor	Stressor	Stressor	• Stressor	• Stressor	• Stressor	• Stressor	• Stressor	• Stressor	• Stressor	Not a stressor	• Stressor

Key	
(blue)	Inconclusive
(pink)	Stressor
(hatched)	Not a stressor
•	Potential Driver

07020011-589 Unnamed Creek

This tributary (WID -589) leads into the mainstem of Rice Creek from Rice Lake. There is one biological monitoring station 08MN009 (Figure 93) that was sampled once in 2008 for Cycle 1 and once in 2018 for the Cycle 2 watershed assessment. In both sample periods, macroinvertebrate samples highlighted a poor community made up completely of tolerant individuals, with very low diversity. The IBI score from the fish sample in 2008 was 34 out of 55. The 2018 sample scored a similarly at 36.7. The 2018 fish sample had less diversity than the 2008 sample with only six species.

Figure 93. Monitoring conditions at 08MN009 on June 23, 2008 (right) and July 31, 2018 (left).

Stressors to Biology

The macroinvertebrate community highlighted displacement in species sensitive to eutrophication, DO, and nitrate. In addition, water chemistry data was collected in 2010 at one downstream station. All collected DO data points fell below the standard of 5 mg/L with the lowest recorded at 0.74 mg/L at 7:48 am. In addition, phosphorus values were at times double the South River Nutrient Region standard (0.15 mg/L). Nitrate concentrations were also elevated falling just under 10 mg/L. While fish metrics were limited as there was a lack in species diversity to measure, habitat showed the largest impact when looking at tolerance scores. Figure 94 below highlights poor instream habitat. The available instream habitat was homogenous, with silt making up much of the stream bed substrate.

Figure 94. MSHA scores in WID -589 within Rice Creek, August 2018.

Inconclusive or not a stressor

TSS is not a clear stressor as there is not a lot of erosion potential to lead to suspended sediment. There may be high amounts of suspended algae that would account for the poor substrate as it settles. For now, TSS is inconclusive as there is not enough data within the chemistry or metrics to confirm. There are not any known barriers that could be affecting migration for fish.

07020011-669 Rice Creek

The mainstem of Rice Creek (WID -669) is one of the longest reaches within the Le Sueur River Watershed. There is a total of six monitoring stations (03MN067, 08MN004, 08MN010, 08MN076, 08MN086, 18MN001), sampled a total of seven times between 2003 and 2018. The only station visited twice was 08MN004, which was sampled in 2008 and 2018 (Figure 95). This station was previously assessed in 2012 and found to be nonsupporting for aquatic life. Current macroinvertebrate data appears somewhat improved, but still shows an overall impaired condition. 08MN004 is the only station that scored above the threshold in both cycle assessments. This site is also the furthest downstream station in the WID. All other stations scored below the threshold. Due to questionable data timed with varying flows at some stations at the time of fish sampling, the status of the fish community was inconclusive. While the status of the fish impairment cannot be listed as passing or failing, some of the fish data may still be used to evaluate or additionally support indications of stressors to the macroinvertebrate community. This stream does have an impairment for turbidity.

Figure 95. Monitoring conditions at 08MN004 on July 23, 2008 (right) and July 15, 2019 (left).

Stressors to biology

Habitat generally improves the further downstream monitoring sites are, apart from the penultimate station of 03MN067 that scored best for habitat availability. Overall, stations that were sampled multiple times scored consistently to what had been surveyed years prior (Figure 96). Channel stability and substrate seemed to have the poorest scores. This would be consistent with signals of TSS impacts and stream impairment for turbidity. Taxa tolerant and very tolerant to nitrate seemed to increase over the years and made up a large percentage of some of the macroinvertebrates sampled. TSS, habitat instability, and nitrate all are driven by altered hydrology as the headwater’s contributing streams are all channelized and nearby land use is dominantly row crop fields.

Figure 96. MSHA scores from all sites across time on Rice Creek WID -669.

Inconclusive or not a stressor

Within the macroinvertebrate community, there was little to show that low DO or eutrophication is limiting the community. However, these parameters are listed as inconclusive as there is a wide range of phosphorus data that has been collected throughout this WID with a maximum value recorded at 0.4 mg/L, well above the standard of 0.15 mg/L. In addition, there have been concerning levels of DO measured ranging from 3.46 to 11.24 mg/L that is indicative of a eutrophic response. Eutrophication and DO are all inconclusive because of conflicting and inconsistent findings. Sediment heavy streams can often displace “filter feeders” and other algae eaters. It is possible if TSS was corrected, the macroinvertebrate community would show a more positive response to eutrophication. For now, sediment driven TSS is playing a larger role in stress compared to eutrophication. Connectivity was found not to be a stressor. There are not any known barriers that would indicate connectivity to be listed as a stressor.

Stressor Identification Summary Table

Table 12. Summary Table of SID for Le Sueur River Watershed

				Dissolved Oxygen				Eutrophication			Nitrate			TSS			Habitat				Connectivity	Altered hydro
WID	**Stream Name**	**Biological Stations**	**Impairment**	Eutrophication	Lack of flow	Wetland/Lake influence	Sediment	Wetland/Lake influence	Excess Phosphorus	Unidentified	Land Use (application)	Upstream waterbody	Point Souce	Suspended Algae	Flow Alterations	Stream Bank Erosion	Channalized	Riparian	Streambed	Habitat diversity		
	Upper Le Sueur																					
664	Le Sueur River	07MN057 18MN007	Support																			
665	Le Sueur River	08MN055	F-IBI M-IBI								•				•	•	•			•		
621	Boot Creek	92MN076	F-IBI								•				•		•	•	•	•	•	•
620	Le Sueur River	08MN048 08MN053	Support																			
573	Little Le Sueur	08MN027	F-IBI	•			•		•		•	•			•	•	•	•	•	•		•
511	County Ditch 35	08MN030	Support																			
	Lower Le Sueur																					
576	Iosco Creek	08MN026	F-IBI inc													•	•				•	•
507	Le Sueur River	03MN037	F-IBI						•		•				•	•			•	•		•
510	Unnamed Creek	08MN032	M-IBI					•	•		•	•			•							•
501	Le Sueur River	08MN001	F-IBI*	Potential delisting																		
	Little Cobb																					
524	County Ditch 8	08MN038 8MN039	F-IBI M-IBI	•		•		•	•		•	•			•	•	•		•	•	•	•
566	County Ditch 20	08MN062	F-IBI																		•	•
613	Unnamed Creek	08MN037	F-IBI								•				•	•	•	•	•	•		•
504	Little Cobb River	08MN006	F-IBI Inc	•	•		•		•		•			•					•	•		•
647	Bull Run Creek	08MN040 18MN010	F-IBI	•	•		•		•								•	•	•	•	•	•
	Cobb River																					
568	Cobb River	08MN067 08MN071	F-IBI M-IBI	•					•		•			•				•	•	•		•
556	Cobb River	08MN005	F-IBI inc	•					•		•		•	•	•	•		•		•		•
541	Judicial Ditch 51	01MN030	Support																			
	Maple River																					
593	County Ditch 85	08MN015 18MN008	F-IBI M-IBI								•				•	•	•		•	•		•
550	County Ditch 3	07MN062	F-IBI M-IBI								•			•	•	•	•	•				•
535	Maple River	08MN091 08MN023	F-IBI M-IBI	•				•				•		•	•	•			•	•		•
534	Maple River	08MN003 08MN019	Support																			
650	Providence Creek	08MN008	M-IBI*	•							•						•	•	•	•		•
652	County Ditch 7	08MN002	F-IBI M-IBI	•			•		•		•				•	•	•		•	•		•
	Rice Creek																					
589	Unnamed Creek	08MN009	F-IBI M-IBI	•		•		•	•		•			•	•		•	•	•	•		•
669	Rice Creek	08MN004	M-IBI	•		•			•		•			•	•	•	•	•	•	•		•

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Appendices

Appendix A. Chem Parameter Summary

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-501	Ammonia-N	36	0.00	0.00	0.30	0.06	0	0	0.0	Null	mg/L
	Chloride	34	9.72	15.55	45.00	18.24	34	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	77	0.00	0.02	0.08	0.02	66	11	14.3	0.04	mg/L
	Chlorophyll-a (uncorrected for periphyton)	6	3.40	6.10	31.00	9.92	0	0	0.0	40.00	ug/L
	Dissolved Orthophosphorus	475	0.00	0.09	0.81	0.11	0	0	0.0	Null	mg/L
	Dissolved oxygen	245	5.43	9.50	16.80	10.00	245	0	0.0	5.00	mg/L
	E.coli	21	13.40	167.00	2,419.60	456.65	10	11	52.4	126.00	MPN/100mL
							19	2	9.5	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	496	0.00	7.34	23.20	7.77	0	0	0.0	Null	mg/L
	pH	242	6.12	8.19	9.87	8.19	241	1	0.4	6.50	
						8.19	239	3	1.2	9.00	
	Specific conductance	295	65.00	615.00	9,370.00	631.34	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	3	0.03	0.29	0.33	0.22	0	0	0.0	Null	mg/L
	Total Phosphorus	493	0.00	0.29	3.48	0.36	143	350	71.0	0.15	mg/L
	Total suspended solids	533	0.00	142.00	3,680.00	260.18	163	370	69.4	65.00	mg/L
	Total volatile solids	64	2.00	20.00	287.00	36.53	0	0	0.0	Null	mg/L
	Transparency, tube with disk	516	1.00	12.00	100.00	21.21	279	237	45.9	10.00	cm
	Volatile suspended solids	183	0.00	15.00	216.00	26.69	0	0	0.0	Null	mg/L
	Water temperature (C)	297	-0.06	15.59	27.76	14.31	0	0	0.0	Null	deg C
07020011-502	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	5.84	7.79	9.74	7.79	2	0	0.0	1.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	4	4.30	7.20	11.77	7.62	0	0	0.0	Null	mg/L
	pH	2	7.47	7.67	7.87	7.67	0	0	0.0	6.00	
							2	0	0.0	9.00	
	Specific conductance	2	704.00	714.50	725.00	714.50	0	0	0.0	Null	uS/cm
	Total Phosphorus	3	0.14	0.14	0.20	0.16	0	0	0.0	Null	mg/L
	Total suspended solids	3	5.60	25.00	30.00	20.20	0	0	0.0	Null	mg/L
	Transparency, tube with disk	2	94.00	97.00	100.00	97.00	0	0	0.0	Null	cm
	Volatile suspended solids	3	3.20	6.00	10.00	6.40	0	0	0.0	Null	mg/L
	Water temperature (C)	2	19.50	20.65	21.80	20.65	0	0	0.0	Null	deg C
07020011-504	Ammonia-N	16	0.00	0.01	0.20	0.03	0	0	0.0	Null	mg/L
	Chloride	17	7.00	13.00	30.00	13.98	17	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	54	0.00	0.03	0.11	0.03	34	20	37.0	0.04	mg/L
	Chlorophyll-a (uncorrected for periphyton)	1	29.00	29.00	29.00	29.00	0	0	0.0	40.00	ug/L
	Dissolved Orthophosphorus	45	0.00	0.10	0.93	0.11	0	0	0.0	Null	mg/L
	Dissolved oxygen	61	3.67	7.01	15.17	7.46	57	4	6.6	5.00	mg/L
	E.coli	35	14.50	238.20	3,654.00	532.10	9	26	74.3	126.00	MPN/100mL
							31	4	11.4	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	89	0.00	7.56	18.10	7.25	0	0	0.0	Null	mg/L
	pH	56	6.15	8.07	10.60	8.20	50	6	10.7	9.00	
							54	2	3.6	6.50	
	Specific conductance	80	145.00	546.80	1,345.00	553.30	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	42	0.00	0.19	0.45	0.17	0	0	0.0	Null	mg/L
	Total Phosphorus	95	0.04	0.22	0.62	0.23	26	69	72.6	0.15	mg/L
	Total suspended solids	111	7.00	38.00	551.00	58.15	85	26	23.4	65.00	mg/L
	Transparency, tube with disk	272	4.00	22.00	83.00	24.28	251	21	7.7	10.00	cm
	Volatile suspended solids	100	2.00	7.60	81.00	10.76	0	0	0.0	Null	mg/L
	Water temperature (C)	140	-0.50	18.50	29.83	17.27	0	0	0.0	Null	deg C
07020011-505	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	7.47	9.89	12.30	9.89	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	0.07	0.07	0.07	0.07	0	0	0.0	Null	mg/L
	pH	2	8.44	8.52	8.59	8.52	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	519.00	527.00	535.00	527.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.25	0.25	0.25	0.25	0	1	100.0	0.15	mg/L
	Total suspended solids	1	39.00	39.00	39.00	39.00	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	136	4.00	20.00	70.00	23.32	120	16	11.8	10.00	cm
	Volatile suspended solids	1	13.00	13.00	13.00	13.00	0	0	0.0	Null	mg/L
	Water temperature (C)	2	22.60	22.85	23.10	22.85	0	0	0.0	Null	deg C
07020011-506	Dissolved oxygen	2	11.25	11.61	11.97	11.61	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	1.40	2.30	3.20	2.30	0	0	0.0	Null	mg/L
	pH	2	7.95	8.15	8.34	8.15	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	252.00	398.50	545.00	398.50	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	2	0.02	0.22	0.42	0.22	0	0	0.0	Null	mg/L
	Total Phosphorus	3	0.04	0.12	1.30	0.49	2	1	33.3	0.15	mg/L
	Total suspended solids	2	18.00	384.00	750.00	384.00	1	1	50.0	65.00	mg/L
	Transparency, tube with disk	2	2.00	31.00	60.00	31.00	1	1	50.0	10.00	cm
	Volatile suspended solids	2	4.40	39.20	74.00	39.20	0	0	0.0	Null	mg/L
	Water temperature (C)	2	3.16	5.69	8.22	5.69	0	0	0.0	Null	deg C

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-507	Ammonia-N	34	0.00	0.03	0.26	0.04	0	0	0.0	Null	mg/L
	Chloride	31	9.00	19.00	54.00	21.19	31	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	114	0.00	0.02	0.07	0.02	102	12	10.5	0.04	mg/L
	Chlorophyll-a (uncorrected for periphyton)	2	8.20	9.05	9.90	9.05	0	0	0.0	40.00	ug/L
	Dissolved Orthophosphorus	317	0.00	0.08	0.89	0.10	0	0	0.0	Null	mg/L
	Dissolved oxygen	350	5.39	9.22	17.90	9.68	350	0	0.0	5.00	mg/L
	E.coli	43	12.20	228.20	9,931.50	917.40	17	26	60.5	126.00	MPN/100mL
							35	8	18.6	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	742	0.00	8.13	24.70	8.46	0	0	0.0	Null	mg/L
	pH	355	6.15	8.16	10.46	8.19	353	2	0.6	6.50	
						8.19	340	15	4.2	9.00	
	Specific conductance	390	5.64	605.45	1,410.00	598.06	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	87	0.00	0.12	0.37	0.13	0	0	0.0	Null	mg/L
	Total Phosphorus	735	0.00	0.28	3.43	0.34	167	568	77.3	0.15	mg/L
	Total suspended solids	744	0.00	127.50	5,340.00	226.73	216	528	71.0	65.00	mg/L
	Total volatile solids	57	6.00	23.00	484.00	44.14	0	0	0.0	Null	mg/L
	Transparency, tube with disk	948	1.00	13.00	100.00	17.20	551	397	41.9	10.00	cm
	Volatile suspended solids	228	2.00	14.00	200.00	22.16	0	0	0.0	Null	mg/L
	Water temperature (C)	414	-0.05	16.34	27.78	14.75	0	0	0.0	Null	deg C
07020011-510	Ammonia-N	1	0.08	0.08	0.08	0.08	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	7.60	7.65	7.70	7.65	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	1.20	1.20	1.20	1.20	0	0	0.0	Null	mg/L
	pH	2	8.00	8.01	8.01	8.01	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	407.00	416.00	425.00	416.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.18	0.18	0.18	0.18	0	1	100.0	0.15	mg/L
	Total suspended solids	1	20.00	20.00	20.00	20.00	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	44.00	52.00	60.00	52.00	2	0	0.0	10.00	cm
	Volatile suspended solids	1	4.80	4.80	4.80	4.80	0	0	0.0	Null	mg/L
	Water temperature (C)	2	22.30	22.75	23.20	22.75	0	0	0.0	Null	deg C
07020011-511	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	7.82	7.84	7.85	7.84	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	3	9.10	13.00	16.00	12.70	0	0	0.0	Null	mg/L
	pH	2	7.65	7.76	7.86	7.76	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	589.00	690.50	792.00	690.50	0	0	0.0	Null	uS/cm
	Total Phosphorus	3	0.02	0.05	0.13	0.07	3	0	0.0	0.15	mg/L
	Total suspended solids	3	0.00	2.40	14.00	5.47	3	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	12.00	47.00	82.00	47.00	2	0	0.0	10.00	cm
	Volatile suspended solids	3	0.00	1.60	3.60	1.73	0	0	0.0	Null	mg/L
	Water temperature (C)	2	19.90	21.45	23.00	21.45	0	0	0.0	Null	deg C
07020011-513	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	4	9.48	14.04	18.81	14.09	4	0	0.0	1.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	9.50	9.50	9.50	9.50	0	0	0.0	Null	mg/L
	pH	4	8.04	8.07	8.28	8.12	0	0	0.0	6.00	
							4	0	0.0	9.00	
	Specific conductance	4	709.70	745.50	856.00	764.18	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.17	0.17	0.17	0.17	0	0	0.0	Null	mg/L
	Total suspended solids	1	27.00	27.00	27.00	27.00	0	0	0.0	Null	mg/L
	Transparency, tube with disk	4	57.00	72.50	86.00	72.00	0	0	0.0	Null	cm
	Volatile suspended solids	1	6.00	6.00	6.00	6.00	0	0	0.0	Null	mg/L
	Water temperature (C)	4	3.60	15.00	23.30	14.23	0	0	0.0	Null	deg C
07020011-516	Ammonia-N	4	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	4	15.60	19.10	42.40	24.05	0	0	0.0	Null	mg/L
	Chlorophyll-a (corrected for periphyton)	17	0.00	0.00	0.04	0.01	0	0	0.0	Null	mg/L
	Dissolved oxygen	25	7.06	8.72	12.25	8.92	25	0	0.0	1.00	mg/L
	E.coli	16	0.00	433.50	1,986.30	561.01	11	5	31.3	630.00	MPN/100mL
							15	1	6.3	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	5	1.80	7.20	16.00	9.15	0	0	0.0	Null	mg/L
	pH	24	6.19	7.82	8.21	7.72	0	0	0.0	6.00	
							24	0	0.0	9.00	
	Specific conductance	25	553.00	732.00	1,422.00	737.80	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	2	0.06	0.10	0.15	0.10	0	0	0.0	Null	mg/L
	Total Phosphorus	23	0.00	0.11	0.18	0.10	0	0	0.0	Null	mg/L
	Total suspended solids	13	0.00	22.00	71.00	23.12	0	0	0.0	Null	mg/L
	Transparency, tube with disk	32	14.50	45.50	100.00	50.34	0	0	0.0	Null	cm
	Volatile suspended solids	2	2.40	2.60	2.80	2.60	0	0	0.0	Null	mg/L
	Water temperature (C)	25	5.50	16.70	25.18	16.99	0	0	0.0	Null	deg C
07020011-518	Inorganic nitrogen (nitrate and nitrite)	1	14.99	14.99	14.99	14.99	0	0	0.0	Null	mg/L
07020011-520	Inorganic nitrogen (nitrate and nitrite)	1	0.53	0.53	0.53	0.53	0	0	0.0	Null	mg/L

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-521	Ammonia-N	2	0.00	0.06	0.11	0.06	0	0	0.0	Null	mg/L
	Chloride	2	15.10	17.40	19.70	17.40	0	0	0.0	Null	mg/L
	Dissolved oxygen	22	4.08	7.89	18.55	8.54	22	0	0.0	1.00	mg/L
	E.coli	13	52.00	155.00	2,419.60	405.82	12	1	7.7	630.00	MPN/100mL
										1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	4	0.52	3.21	4.10	2.76	0	0	0.0	Null	mg/L
	pH	22	6.47	7.82	8.85	7.70	0	0	0.0	6.00	
							22	0	0.0	9.00	
	Specific conductance	22	306.20	489.65	967.00	484.06	0	0	0.0	Null	uS/cm
	Total Phosphorus	12	0.08	0.16	0.34	0.18	0	0	0.0	Null	mg/L
	Total suspended solids	12	7.00	22.50	52.00	24.92	0	0	0.0	Null	mg/L
	Transparency, tube with disk	22	13.00	29.25	71.00	31.64	0	0	0.0	Null	cm
	Volatile suspended solids	2	10.00	14.00	18.00	14.00	0	0	0.0	Null	mg/L
	Water temperature (C)	22	8.05	21.85	27.90	20.89	0	0	0.0	Null	deg C
07020011-522	Inorganic nitrogen (nitrate and nitrite)	2	3.29	3.57	3.85	3.57	0	0	0.0	Null	mg/L
07020011-524	Ammonia-N	5	0.00	0.00	0.96	0.19	0	0	0.0	Null	mg/L
	Chloride	1	17.30	17.30	17.30	17.30	1	0	0.0	230.00	mg/L
	Dissolved oxygen	6	7.11	8.24	13.16	9.31	6	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	5	5.10	9.00	14.00	8.46	0	0	0.0	Null	mg/L
	pH	6	7.93	8.05	8.20	8.06	6	0	0.0	6.50	
										9.00	
	Specific conductance	6	550.00	598.50	706.00	607.33	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.09	0.09	0.09	0.09	0	0	0.0	Null	mg/L
	Total Phosphorus	4	0.08	0.10	0.13	0.10	4	0	0.0	0.15	mg/L
	Total suspended solids	5	12.00	14.00	25.00	15.64	5	0	0.0	65.00	mg/L
	Transparency, tube with disk	5	12.00	36.00	58.00	33.40	5	0	0.0	10.00	cm
	Volatile suspended solids	5	2.80	3.20	4.80	3.36	0	0	0.0	Null	mg/L
	Water temperature (C)	6	5.61	22.55	26.90	20.30	0	0	0.0	Null	deg C
07020011-530	Dissolved Orthophosphorus	1	0.02	0.02	0.02	0.02	0	0	0.0	Null	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	5.00	5.18	5.36	5.18	0	0	0.0	Null	mg/L
	Total Phosphorus	2	0.05	0.07	0.08	0.07	2	0	0.0	0.15	mg/L
	Total suspended solids	2	2.40	7.20	12.00	7.20	2	0	0.0	65.00	mg/L
	Volatile suspended solids	1	2.00	2.00	2.00	2.00	0	0	0.0	Null	mg/L
	Water temperature (C)	1	17.64	17.64	17.64	17.64	0	0	0.0	Null	deg C
07020011-532	Inorganic nitrogen (nitrate and nitrite)	1	9.21	9.21	9.21	9.21	0	0	0.0	Null	mg/L
07020011-533	Dissolved oxygen	2	7.59	9.44	11.29	9.44	2	0	0.0	1.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	9.62	9.62	9.62	9.62	0	0	0.0	Null	mg/L
	Transparency, tube with disk	2	33.00	46.50	60.00	46.50	0	0	0.0	Null	cm
	Water temperature (C)	2	17.70	20.30	22.90	20.30	0	0	0.0	Null	deg C
07020011-534	Ammonia-N	3	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	2	13.20	13.25	13.30	13.25	2	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	16	0.00	0.01	0.05	0.01	14	2	12.5	0.04	mg/L
	Dissolved Orthophosphorus	403	0.00	0.12	0.87	0.14	0	0	0.0	Null	mg/L
	Dissolved oxygen	361	4.18	9.40	14.97	9.64	360	1	0.3	5.00	mg/L
	E.coli	145	10.00	186.00	2,419.60	421.96	56	89	61.4	126.00	MPN/100mL
							132	13	9.0	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	716	0.00	8.05	23.40	8.56	0	0	0.0	Null	mg/L
	pH	353	7.01	8.09	9.98	8.10	350	3	0.8	9.00	
							353	0	0.0	6.50	
	Specific conductance	364	178.00	667.00	1,417.00	648.45	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	2	0.30	0.32	0.33	0.32	0	0	0.0	Null	mg/L
	Total Phosphorus	731	0.00	0.25	1.52	0.31	178	553	75.6	0.15	mg/L
	Total suspended solids	712	0.00	58.00	2,040.00	136.91	383	329	46.2	65.00	mg/L
	Total volatile solids	114	3.00	12.50	273.00	26.82	0	0	0.0	Null	mg/L
	Transparency, tube with disk	1,049	1.50	17.00	100.00	23.44	782	267	25.5	10.00	cm
	Volatile suspended solids	190	0.00	11.00	113.00	16.06	0	0	0.0	Null	mg/L
	Water temperature (C)	370	-0.02	16.00	27.50	14.47	0	0	0.0	Null	deg C
07020011-535	Ammonia-N	18	0.00	0.00	1.05	0.13	0	0	0.0	Null	mg/L
	Chloride	1	17.50	17.50	17.50	17.50	1	0	0.0	230.00	mg/L
	Dissolved oxygen	16	6.78	8.36	11.99	8.76	16	0	0.0	5.00	mg/L
	E.coli	1	209.80	209.80	209.80	209.80	0	1	100.0	126.00	MPN/100mL
							1	0	0.0	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	23	0.00	4.90	8.90	4.45	0	0	0.0	Null	mg/L
	pH	16	7.83	8.20	8.64	8.21	16	0	0.0	6.50	
										9.00	
	Specific conductance	16	485.00	649.00	786.00	641.94	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.25	0.25	0.25	0.25	0	0	0.0	Null	mg/L
	Total Phosphorus	18	0.06	0.14	0.35	0.16	10	8	44.4	0.15	mg/L
	Total suspended solids	18	5.20	23.00	99.00	25.03	17	1	5.6	65.00	mg/L
	Transparency, tube with disk	136	10.00	20.00	100.00	23.00	130	6	4.4	10.00	cm

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-535	Volatile suspended solids	17	2.80	6.00	15.00	7.61	0	0	0.0	Null	mg/L
	Water temperature (C)	65	0.00	20.56	28.33	18.55	0	0	0.0	Null	deg C
07020011-541	Ammonia-N	1	0.05	0.05	0.05	0.05	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	8.38	9.43	10.48	9.43	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	7.40	7.40	7.40	7.40	0	0	0.0	Null	mg/L
	pH	2	8.12	8.19	8.26	8.19	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	626.00	662.00	698.00	662.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.13	0.13	0.13	0.13	1	0	0.0	0.15	mg/L
	Total suspended solids	1	39.00	39.00	39.00	39.00	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	17.00	19.00	21.00	19.00	2	0	0.0	10.00	cm
	Volatile suspended solids	1	7.20	7.20	7.20	7.20	0	0	0.0	Null	mg/L
	Water temperature (C)	2	23.60	23.95	24.30	23.95	0	0	0.0	Null	deg C
07020011-550	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	9.10	10.74	12.38	10.74	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	10.00	10.00	10.00	10.00	0	0	0.0	Null	mg/L
	pH	2	8.15	8.18	8.20	8.18	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	729.00	740.00	751.00	740.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.08	0.08	0.08	0.08	1	0	0.0	0.15	mg/L
	Total suspended solids	1	10.00	10.00	10.00	10.00	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	72.00	83.00	94.00	83.00	2	0	0.0	10.00	cm
	Volatile suspended solids	1	3.20	3.20	3.20	3.20	0	0	0.0	Null	mg/L
	Water temperature (C)	2	25.90	26.55	27.20	26.55	0	0	0.0	Null	deg C
07020011-556	Ammonia-N	24	0.00	0.00	1.78	0.11	0	0	0.0	Null	mg/L
	Chloride	19	8.00	12.80	34.00	13.88	19	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	57	0.00	0.03	0.09	0.03	40	17	29.8	0.04	mg/L
	Chlorophyll-a (uncorrected for periphyton)	1	26.00	26.00	26.00	26.00	0	0	0.0	40.00	ug/L
	Dissolved Orthophosphorus	175	0.00	0.09	0.98	0.11	0	0	0.0	Null	mg/L
	Dissolved oxygen	196	4.87	9.33	16.90	9.66	195	1	0.5	5.00	mg/L
	E.coli	22	13.50	131.00	2,737.50	523.62	11	11	50.0	126.00	MPN/100mL
							19	3	13.6	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	384	0.00	8.20	23.80	8.49	0	0	0.0	Null	mg/L
	pH	197	6.02	8.19	10.63	8.20	189	8	4.1	9.00	
						8.20	196	1	0.5	6.50	
	Specific conductance	217	125.00	577.80	1,192.00	568.97	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	46	0.00	0.16	0.37	0.16	0	0	0.0	Null	mg/L
	Total Phosphorus	380	0.02	0.24	1.17	0.29	99	281	73.9	0.15	mg/L
	Total suspended solids	379	0.00	82.00	1,150.00	128.55	155	224	59.1	65.00	mg/L
	Total volatile solids	54	2.00	15.00	182.00	25.96	0	0	0.0	Null	mg/L
	Transparency, tube with disk	375	2.00	14.00	100.00	19.73	248	127	33.9	10.00	cm
	Volatile suspended solids	119	3.00	11.00	82.00	14.85	0	0	0.0	Null	mg/L
	Water temperature (C)	260	-0.02	17.60	28.33	16.18	0	0	0.0	Null	deg C
07020011-558	Transparency, tube with disk	124	0.00	77.50	100.00	71.30	120	4	3.2	10.00	cm
07020011-562	Inorganic nitrogen (nitrate and nitrite)	1	11.07	11.07	11.07	11.07	0	0	0.0	Null	mg/L
07020011-566	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	8.70	8.83	8.96	8.83	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	13.00	13.50	14.00	13.50	0	0	0.0	Null	mg/L
	pH	2	8.25	8.29	8.33	8.29	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	605.00	669.00	733.00	669.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	2	0.10	0.10	0.11	0.10	2	0	0.0	0.15	mg/L
	Total suspended solids	2	4.40	8.20	12.00	8.20	2	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	47.00	56.00	65.00	56.00	2	0	0.0	10.00	cm
	Volatile suspended solids	2	2.80	3.00	3.20	3.00	0	0	0.0	Null	mg/L
	Water temperature (C)	2	17.10	18.15	19.20	18.15	0	0	0.0	Null	deg C
07020011-568	Ammonia-N	10	0.00	0.06	1.80	0.44	0	0	0.0	Null	mg/L
	Chloride	1	15.90	15.90	15.90	15.90	1	0	0.0	230.00	mg/L
	Dissolved oxygen	7	6.31	7.51	10.64	7.76	7	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	20	3.40	8.48	14.00	8.75	0	0	0.0	Null	mg/L
	pH	7	7.88	8.21	8.29	8.16	7	0	0.0	6.50	
										9.00	
	Specific conductance	7	471.00	529.00	694.00	550.00	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.15	0.15	0.15	0.15	0	0	0.0	Null	mg/L
	Total Phosphorus	11	0.02	0.14	0.23	0.14	6	5	45.5	0.15	mg/L
	Total suspended solids	10	8.40	23.50	87.00	35.64	8	2	20.0	65.00	mg/L
	Transparency, tube with disk	6	16.00	28.00	49.00	30.17	6	0	0.0	10.00	cm
	Volatile suspended solids	10	2.80	4.80	12.00	6.64	0	0	0.0	Null	mg/L
	Water temperature (C)	7	6.01	22.20	24.30	20.03	0	0	0.0	Null	deg C
07020011-573	Ammonia-N	2	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-573	Dissolved oxygen	2	8.17	8.32	8.46	8.32	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	2.50	5.21	7.91	5.21	0	0	0.0	Null	mg/L
	pH	2	8.07	8.19	8.30	8.19	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	660.00	666.00	672.00	666.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.10	0.10	0.10	0.10	1	0	0.0	0.15	mg/L
	Total suspended solids	1	4.40	4.40	4.40	4.40	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	82.00	91.00	100.00	91.00	2	0	0.0	10.00	cm
	Volatile suspended solids	1	1.60	1.60	1.60	1.60	0	0	0.0	Null	mg/L
	Water temperature (C)	2	18.30	21.15	24.00	21.15	0	0	0.0	Null	deg C
07020011-576	Ammonia-N	2	0.00	0.03	0.05	0.03	0	0	0.0	Null	mg/L
	Dissolved oxygen	3	8.34	9.31	9.72	9.12	3	0	0.0	5.00	mg/L
	E.coli	89	40.40	717.00	24,196.00	2,664.92	6	83	93.3	126.00	MPN/100mL
							60	29	32.6	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	121	0.25	6.69	14.40	6.79	0	0	0.0	Null	mg/L
	pH	3	7.93	8.22	8.23	8.13	3	0	0.0	6.50	
										9.00	
	Specific conductance	3	575.00	643.00	701.00	639.67	0	0	0.0	Null	uS/cm
	Total Phosphorus	120	0.04	0.20	0.62	0.22	34	86	71.7	0.15	mg/L
	Total suspended solids	120	0.00	18.00	207.00	23.84	116	4	3.3	65.00	mg/L
	Transparency, tube with disk	89	8.20	37.20	100.00	41.83	87	2	2.2	10.00	cm
	Volatile suspended solids	7	1.60	3.60	5.20	3.20	0	0	0.0	Null	mg/L
	Water temperature (C)	77	5.40	19.80	26.70	18.91	0	0	0.0	Null	deg C
07020011-577	Ammonia-N	2	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	7.94	8.22	8.49	8.22	2	0	0.0	1.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	5	6.50	10.42	15.00	10.98	0	0	0.0	Null	mg/L
	pH	2	7.86	7.90	7.93	7.90	0	0	0.0	6.00	
							2	0	0.0	9.00	
	Specific conductance	2	500.00	605.00	710.00	605.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	2	0.06	0.08	0.10	0.08	0	0	0.0	Null	mg/L
	Total suspended solids	2	12.00	18.00	24.00	18.00	0	0	0.0	Null	mg/L
	Transparency, tube with disk	2	12.00	28.00	44.00	28.00	0	0	0.0	Null	cm
	Volatile suspended solids	2	4.00	4.60	5.20	4.60	0	0	0.0	Null	mg/L
	Water temperature (C)	2	20.00	20.10	20.20	20.10	0	0	0.0	Null	deg C
07020011-581	Ammonia-N	2	0.00	0.89	1.78	0.89	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	10.76	10.99	11.22	10.99	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	2.20	2.20	2.20	2.20	0	0	0.0	Null	mg/L
	pH	2	7.75	7.81	7.86	7.81	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	523.00	555.00	587.00	555.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.29	0.29	0.29	0.29	0	1	100.0	0.15	mg/L
	Total suspended solids	1	4.00	4.00	4.00	4.00	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	84.00	92.00	100.00	92.00	2	0	0.0	10.00	cm
	Volatile suspended solids	1	1.20	1.20	1.20	1.20	0	0	0.0	Null	mg/L
	Water temperature (C)	2	21.70	22.25	22.80	22.25	0	0	0.0	Null	deg C
07020011-589	Ammonia-N	2	0.00	0.15	0.30	0.15	0	0	0.0	Null	mg/L
	Chloride	1	12.30	12.30	12.30	12.30	1	0	0.0	230.00	mg/L
	Dissolved oxygen	6	0.74	3.83	5.25	3.51	1	5	83.3	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	6	0.00	1.01	9.70	2.31	0	0	0.0	Null	mg/L
	pH	4	7.39	7.49	7.62	7.50	4	0	0.0	6.50	
										9.00	
	Specific conductance	4	286.20	423.00	450.00	395.55	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.03	0.03	0.03	0.03	0	0	0.0	Null	mg/L
	Total Phosphorus	5	0.07	0.11	0.23	0.13	3	2	40.0	0.15	mg/L
	Total suspended solids	4	2.80	10.60	22.00	11.50	4	0	0.0	65.00	mg/L
	Transparency, tube with disk	5	16.50	45.00	76.00	40.70	5	0	0.0	10.00	cm
	Volatile suspended solids	4	2.40	5.20	9.60	5.60	0	0	0.0	Null	mg/L
	Water temperature (C)	6	21.82	23.82	28.30	24.28	0	0	0.0	Null	deg C
07020011-591	Inorganic nitrogen (nitrate and nitrite)	2	7.20	9.53	11.85	9.53	0	0	0.0	Null	mg/L
	Total Phosphorus	1	0.04	0.04	0.04	0.04	1	0	0.0	0.15	mg/L
	Total suspended solids	1	15.00	15.00	15.00	15.00	1	0	0.0	65.00	mg/L
	Volatile suspended solids	1	4.80	4.80	4.80	4.80	0	0	0.0	Null	mg/L
07020011-592	Ammonia-N	1	0.05	0.05	0.05	0.05	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	7.03	9.05	11.06	9.05	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	3	8.60	9.64	12.00	10.08	0	0	0.0	Null	mg/L
	pH	2	7.97	8.12	8.27	8.12	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	701.00	722.50	744.00	722.50	0	0	0.0	Null	uS/cm
	Total Phosphorus	2	0.01	0.04	0.07	0.04	2	0	0.0	0.15	mg/L
	Total suspended solids	2	2.80	20.40	38.00	20.40	2	0	0.0	65.00	mg/L

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-592	Transparency, tube with disk	2	25.00	46.50	68.00	46.50	2	0	0.0	10.00	cm
	Volatile suspended solids	2	2.40	4.20	6.00	4.20	0	0	0.0	Null	mg/L
	Water temperature (C)	2	19.70	22.50	25.30	22.50	0	0	0.0	Null	deg C
07020011-593	Inorganic nitrogen (nitrate and nitrite)	1	6.30	6.30	6.30	6.30	0	0	0.0	Null	mg/L
	Total Phosphorus	1	0.05	0.05	0.05	0.05	1	0	0.0	0.15	mg/L
	Total suspended solids	1	2.00	2.00	2.00	2.00	1	0	0.0	65.00	mg/L
	Volatile suspended solids	1	2.00	2.00	2.00	2.00	0	0	0.0	Null	mg/L
07020011-609	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	4	7.18	8.11	9.04	8.11	4	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	7.40	7.40	7.40	7.40	0	0	0.0	Null	mg/L
	pH	2	8.10	8.12	8.14	8.12	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	828.00	840.50	853.00	840.50	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.21	0.21	0.21	0.21	0	1	100.0	0.15	mg/L
	Total suspended solids	1	8.40	8.40	8.40	8.40	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	4	15.00	38.00	66.00	39.25	4	0	0.0	10.00	cm
	Volatile suspended solids	1	2.40	2.40	2.40	2.40	0	0	0.0	Null	mg/L
	Water temperature (C)	4	15.50	18.60	18.90	17.90	0	0	0.0	Null	deg C
07020011-613	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	7.90	8.18	8.45	8.18	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	9.90	9.90	9.90	9.90	0	0	0.0	Null	mg/L
	pH	2	8.19	8.19	8.19	8.19	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	592.00	666.50	741.00	666.50	0	0	0.0	Null	uS/cm
	Total Phosphorus	1	0.10	0.10	0.10	0.10	1	0	0.0	0.15	mg/L
	Total suspended solids	1	28.00	28.00	28.00	28.00	1	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	15.00	18.50	22.00	18.50	2	0	0.0	10.00	cm
	Volatile suspended solids	1	5.20	5.20	5.20	5.20	0	0	0.0	Null	mg/L
	Water temperature (C)	2	17.70	18.50	19.30	18.50	0	0	0.0	Null	deg C
07020011-615	Inorganic nitrogen (nitrate and nitrite)	2	8.89	10.80	12.70	10.80	0	0	0.0	Null	mg/L
07020011-617	Ammonia-N	4	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	4	5.10	13.30	31.00	15.68	4	0	0.0	230.00	mg/L
	Dissolved oxygen	4	3.95	7.04	7.46	6.37	3	1	25.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	4	0.00	5.75	24.00	8.88	0	0	0.0	Null	mg/L
	pH	3	6.88	7.13	7.42	7.14	3	0	0.0	6.50	
										9.00	
	Specific conductance	4	299.00	684.50	737.00	601.25	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	4	0.12	0.18	1.08	0.39	0	0	0.0	Null	mg/L
	Total Phosphorus	4	0.14	0.19	1.28	0.45	1	3	75.0	0.15	mg/L
	Transparency, tube with disk	2	8.00	34.00	60.00	34.00	1	1	50.0	10.00	cm
	Water temperature (C)	4	15.12	18.80	24.97	19.42	0	0	0.0	Null	deg C
07020011-618	Inorganic nitrogen (nitrate and nitrite)	1	10.14	10.14	10.14	10.14	0	0	0.0	Null	mg/L
07020011-620	Ammonia-N	9	0.00	0.00	0.09	0.01	0	0	0.0	Null	mg/L
	Chloride	2	13.10	18.35	23.60	18.35	2	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	16	0.00	0.01	0.02	0.01	16	0	0.0	0.04	mg/L
	Dissolved oxygen	47	6.66	8.33	16.41	8.79	47	0	0.0	5.00	mg/L
	E.coli	8	173.00	422.50	1,178.00	493.61	0	8	100.0	126.00	MPN/100mL
							8	0	0.0	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	19	1.20	6.10	13.00	6.69	0	0	0.0	Null	mg/L
	pH	38	7.44	8.14	8.80	8.09	38	0	0.0	6.50	
						8.09	38	0	0.0	9.00	
	Specific conductance	39	246.00	672.00	1,403.00	694.50	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	2	0.07	0.15	0.23	0.15	0	0	0.0	Null	mg/L
	Total Phosphorus	28	0.10	0.16	0.33	0.18	12	16	57.1	0.15	mg/L
	Total suspended solids	10	2.80	21.50	34.00	20.76	10	0	0.0	65.00	mg/L
	Transparency, tube with disk	90	2.00	20.00	100.00	28.72	71	19	21.1	10.00	cm
	Volatile suspended solids	10	0.00	5.80	8.40	4.68	0	0	0.0	Null	mg/L
	Water temperature (C)	47	2.40	19.70	27.00	19.22	0	0	0.0	Null	deg C
07020011-621	Ammonia-N	4	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	3	14.60	15.00	26.90	18.83	3	0	0.0	230.00	mg/L
	Dissolved oxygen	4	8.23	11.06	12.32	10.67	4	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	5	1.50	13.00	16.00	11.45	0	0	0.0	Null	mg/L
	pH	3	7.33	8.18	8.35	7.95	3	0	0.0	6.50	
										9.00	
	Specific conductance	4	555.00	608.00	691.00	615.50	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	2	0.02	0.07	0.11	0.07	0	0	0.0	Null	mg/L
	Total Phosphorus	3	0.06	0.08	0.13	0.09	3	0	0.0	0.15	mg/L
	Total suspended solids	2	18.00	18.20	18.40	18.20	2	0	0.0	65.00	mg/L
	Transparency, tube with disk	3	36.00	43.00	72.00	50.33	3	0	0.0	10.00	cm
	Volatile suspended solids	2	4.00	4.00	4.00	4.00	0	0	0.0	Null	mg/L

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-621	Water temperature (C)	4	15.85	25.45	27.93	23.67	0	0	0.0	Null	deg C
07020011-624	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	1	15.00	15.00	15.00	15.00	1	0	0.0	230.00	mg/L
	Dissolved oxygen	1	7.87	7.87	7.87	7.87	1	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	14.00	14.00	14.00	14.00	0	0	0.0	Null	mg/L
	pH	1	7.27	7.27	7.27	7.27	1	0	0.0	6.50	
										9.00	
	Specific conductance	1	695.00	695.00	695.00	695.00	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.16	0.16	0.16	0.16	0	0	0.0	Null	mg/L
	Total Phosphorus	1	0.18	0.18	0.18	0.18	0	1	100.0	0.15	mg/L
	Transparency, tube with disk	1	37.00	37.00	37.00	37.00	1	0	0.0	10.00	cm
	Water temperature (C)	1	17.73	17.73	17.73	17.73	0	0	0.0	Null	deg C
07020011-625	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	1	10.50	10.50	10.50	10.50	1	0	0.0	230.00	mg/L
	Dissolved oxygen	1	6.20	6.20	6.20	6.20	1	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	1	12.00	12.00	12.00	12.00	0	0	0.0	Null	mg/L
	pH	1	7.15	7.15	7.15	7.15	1	0	0.0	6.50	
										9.00	
	Specific conductance	1	714.00	714.00	714.00	714.00	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.04	0.04	0.04	0.04	0	0	0.0	Null	mg/L
	Total Phosphorus	1	0.04	0.04	0.04	0.04	1	0	0.0	0.15	mg/L
	Transparency, tube with disk	1	60.00	60.00	60.00	60.00	1	0	0.0	10.00	cm
	Water temperature (C)	1	15.22	15.22	15.22	15.22	0	0	0.0	Null	deg C
07020011-626	Ammonia-N	2	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	2	3.84	4.57	5.29	4.57	2	0	0.0	230.00	mg/L
	Dissolved oxygen	2	2.65	5.73	8.80	5.73	1	1	50.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	0.00	1.45	2.90	1.45	0	0	0.0	Null	mg/L
	pH	2	7.23	7.31	7.39	7.31	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	325.00	420.00	515.00	420.00	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	2	0.12	0.33	0.55	0.33	0	0	0.0	Null	mg/L
	Total Phosphorus	2	0.15	0.43	0.71	0.43	1	1	50.0	0.15	mg/L
	Water temperature (C)	2	5.50	8.23	10.95	8.23	0	0	0.0	Null	deg C
07020011-627	Dissolved oxygen	2	2.94	3.17	3.39	3.17	0	2	100.0	5.00	mg/L
	Transparency, tube with disk	4	8.00	21.75	48.00	24.88	3	1	25.0	10.00	cm
	Water temperature (C)	2	22.90	25.20	27.50	25.20	0	0	0.0	Null	deg C
07020011-630	Total Phosphorus	42	0.00	0.06	0.25	0.06	41	1	2.4	0.15	mg/L
	Total suspended solids	42	1.00	11.00	63.00	13.36	42	0	0.0	65.00	mg/L
	Transparency, tube with disk	111	13.00	57.00	100.00	56.40	111	0	0.0	10.00	cm
	Water temperature (C)	111	5.56	23.89	30.00	23.33	0	0	0.0	Null	deg C
07020011-632	Total Phosphorus	2	0.17	0.27	0.37	0.27	0	2	100.0	0.15	mg/L
	Total suspended solids	2	2.00	4.00	6.00	4.00	2	0	0.0	65.00	mg/L
	Transparency, tube with disk	94	2.00	100.00	100.00	81.87	92	2	2.1	10.00	cm
	Water temperature (C)	94	6.67	20.00	27.22	19.03	0	0	0.0	Null	deg C
07020011-633	Ammonia-N	4	0.06	0.12	0.91	0.30	0	0	0.0	Null	mg/L
	Chloride	31	5.95	13.40	22.20	13.23	31	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	25	0.00	0.02	0.05	0.02	21	4	16.0	0.04	mg/L
	Dissolved oxygen	32	0.26	3.13	10.85	3.60	10	22	68.8	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	31	0.00	0.00	3.20	0.14	0	0	0.0	Null	mg/L
	pH	31	6.90	7.51	8.65	7.52	31	0	0.0	6.50	
										9.00	
	Specific conductance	32	300.00	437.40	615.80	436.04	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	4	0.01	0.08	0.14	0.08	0	0	0.0	Null	mg/L
	Total Phosphorus	79	0.01	0.18	1.41	0.22	31	48	60.8	0.15	mg/L
	Total suspended solids	79	0.00	8.00	54.00	10.59	79	0	0.0	65.00	mg/L
	Transparency, tube with disk	132	5.00	80.00	100.00	75.70	130	2	1.5	10.00	cm
	Volatile suspended solids	31	0.00	4.80	37.00	6.81	0	0	0.0	Null	mg/L
	Water temperature (C)	133	5.56	21.39	33.33	20.47	0	0	0.0	Null	deg C
07020011-634	Total Phosphorus	59	0.08	0.21	0.55	0.21	21	38	64.4	0.15	mg/L
	Total suspended solids	59	0.00	7.00	29.00	8.85	59	0	0.0	65.00	mg/L
	Transparency, tube with disk	132	15.00	60.50	100.00	62.72	132	0	0.0	10.00	cm
	Water temperature (C)	131	5.56	22.22	29.44	20.84	0	0	0.0	Null	deg C
07020011-636	Ammonia-N	3	0.07	0.13	0.14	0.11	0	0	0.0	Null	mg/L
	Chloride	33	4.57	11.90	22.40	12.31	33	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	27	0.00	0.01	0.04	0.01	27	0	0.0	0.04	mg/L
	Dissolved oxygen	34	0.21	1.98	17.48	2.95	6	28	82.4	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	33	0.00	0.08	4.00	0.60	0	0	0.0	Null	mg/L
	pH	33	6.96	7.35	8.53	7.40	33	0	0.0	6.50	
										9.00	
	Specific conductance	34	223.00	443.45	566.30	439.16	0	0	0.0	Null	uS/cm

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-636	Total Orthophosphorus	3	0.10	0.10	0.32	0.17	0	0	0.0	Null	mg/L
	Total Phosphorus	91	0.05	0.25	1.62	0.31	22	69	75.8	0.15	mg/L
	Total suspended solids	91	0.00	4.40	120.00	8.21	89	2	2.2	65.00	mg/L
	Transparency, tube with disk	160	11.00	85.00	100.00	79.44	160	0	0.0	10.00	cm
	Volatile suspended solids	33	0.00	4.00	22.00	4.53	0	0	0.0	Null	mg/L
	Water temperature (C)	163	4.44	21.11	31.11	19.93	0	0	0.0	Null	deg C
07020011-639	Total Phosphorus	5	0.05	0.09	0.47	0.16	4	1	20.0	0.15	mg/L
	Total suspended solids	5	2.00	14.00	216.00	51.00	4	1	20.0	65.00	mg/L
	Transparency, tube with disk	107	5.00	100.00	100.00	81.25	104	3	2.8	10.00	cm
	Water temperature (C)	107	5.56	18.89	26.67	17.71	0	0	0.0	Null	deg C
07020011-642	Ammonia-N	12	0.00	0.04	0.41	0.09	0	0	0.0	Null	mg/L
	Chloride	12	7.00	13.00	17.00	12.58	12	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	57	0.00	0.01	0.08	0.01	55	2	3.5	0.04	mg/L
	Chlorophyll-a (uncorrected for periphyton)	1	8.10	8.10	8.10	8.10	0	0	0.0	40.00	ug/L
	Dissolved Orthophosphorus	114	0.01	0.11	0.87	0.14	0	0	0.0	Null	mg/L
	Dissolved oxygen	89	1.99	8.95	18.63	9.37	85	4	4.5	5.00	mg/L
	E.coli	19	3.00	165.00	2,419.60	761.33	8	11	57.9	126.00	MPN/100mL
							14	5	26.3	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	187	0.06	12.74	29.70	13.29	0	0	0.0	Null	mg/L
	pH	94	5.88	7.81	10.52	7.86	92	2	2.1	6.50	
						7.86	90	4	4.3	9.00	
	Specific conductance	102	69.60	654.00	1,336.00	646.00	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	43	0.00	0.21	0.62	0.21	0	0	0.0	Null	mg/L
	Total Phosphorus	185	0.00	0.21	1.28	0.27	72	113	61.1	0.15	mg/L
	Total suspended solids	188	0.00	25.50	936.00	65.01	149	39	20.7	65.00	mg/L
	Total volatile solids	43	2.00	8.00	104.00	14.88	0	0	0.0	Null	mg/L
	Transparency, tube with disk	143	3.00	42.00	100.00	44.51	119	24	16.8	10.00	cm
	Volatile suspended solids	101	0.00	4.00	84.00	6.99	0	0	0.0	Null	mg/L
	Water temperature (C)	104	-0.02	13.43	29.90	12.66	0	0	0.0	Null	deg C
07020011-644	Inorganic nitrogen (nitrate and nitrite)	1	6.70	6.70	6.70	6.70	0	0	0.0	Null	mg/L
07020011-645	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	8.19	8.24	8.29	8.24	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	8.60	8.70	8.80	8.70	0	0	0.0	Null	mg/L
	pH	2	8.27	8.33	8.38	8.33	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	559.00	617.00	675.00	617.00	0	0	0.0	Null	uS/cm
	Total Phosphorus	2	0.04	0.05	0.06	0.05	2	0	0.0	0.15	mg/L
	Total suspended solids	2	6.00	13.00	20.00	13.00	2	0	0.0	65.00	mg/L
	Transparency, tube with disk	2	15.00	57.50	100.00	57.50	2	0	0.0	10.00	cm
	Volatile suspended solids	2	2.80	3.80	4.80	3.80	0	0	0.0	Null	mg/L
	Water temperature (C)	2	20.60	21.70	22.80	21.70	0	0	0.0	Null	deg C
07020011-647	Ammonia-N	2	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	4	6.48	8.33	10.18	8.33	4	0	0.0	5.00	mg/L
	E.coli	85	0.00	886.00	17,329.00	1,667.97	12	73	85.9	126.00	MPN/100mL
							56	29	34.1	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	111	0.00	8.01	14.90	7.31	0	0	0.0	Null	mg/L
	pH	2	8.33	8.38	8.42	8.38	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	515.00	521.50	528.00	521.50	0	0	0.0	Null	uS/cm
	Total Phosphorus	111	0.05	0.17	0.53	0.18	47	64	57.7	0.15	mg/L
	Total suspended solids	111	5.00	52.00	375.00	61.44	82	29	26.1	65.00	mg/L
	Transparency, tube with disk	85	6.50	12.99	60.00	16.62	66	19	22.4	10.00	cm
	Volatile suspended solids	2	15.00	16.00	17.00	16.00	0	0	0.0	Null	mg/L
	Water temperature (C)	81	5.30	20.10	28.00	19.17	0	0	0.0	Null	deg C
07020011-648	Ammonia-N	3	0.00	0.00	0.22	0.07	0	0	0.0	Null	mg/L
	Chloride	1	18.20	18.20	18.20	18.20	0	0	0.0	Null	mg/L
	Dissolved oxygen	4	5.70	7.34	13.50	8.47	0	0	0.0	Null	mg/L
	Inorganic nitrogen (nitrate and nitrite)	5	7.80	8.00	9.00	8.15	0	0	0.0	Null	mg/L
	pH	4	7.48	8.04	8.62	8.04	0	0	0.0	Null	
	Specific conductance	4	6.57	553.00	681.00	448.39	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.20	0.20	0.20	0.20	0	0	0.0	Null	mg/L
	Total Phosphorus	4	0.06	0.11	0.23	0.13	0	0	0.0	Null	mg/L
	Total suspended solids	3	8.80	8.80	8.80	8.80	0	0	0.0	Null	mg/L
	Transparency, tube with disk	3	41.00	63.00	100.00	68.00	0	0	0.0	Null	cm
	Volatile suspended solids	3	2.80	3.20	3.60	3.20	0	0	0.0	Null	mg/L
	Water temperature (C)	4	5.02	21.50	23.90	17.98	0	0	0.0	Null	deg C
07020011-652	Ammonia-N	2	0.00	0.49	0.98	0.49	0	0	0.0	Null	mg/L
	Chloride	2	12.30	14.70	17.10	14.70	0	0	0.0	Null	mg/L
	Dissolved oxygen	21	5.42	9.34	12.24	9.34	0	0	0.0	Null	mg/L
	E.coli	15	259.00	479.00	7,701.00	1,039.00	0	0	0.0	Null	MPN/100mL

Parameters by WID

WID	Parameters	# of Samples	Min Value	Median Value	Max Value	Avg Value	# Meeting Standard	# Exceeding Standard	% Exceeding	Criteria Val	Result Units
07020011-652	Inorganic nitrogen (nitrate and nitrite)	4	5.20	10.16	12.00	9.38	0	0	0.0	Null	mg/L
	pH	21	7.26	7.87	8.23	7.85	0	0	0.0	Null	
	Specific conductance	21	660.00	746.00	1,480.00	773.17	0	0	0.0	Null	uS/cm
	Total Phosphorus	13	0.03	0.12	0.25	0.12	0	0	0.0	Null	mg/L
	Total suspended solids	13	8.40	26.00	107.00	34.26	0	0	0.0	Null	mg/L
	Transparency, tube with disk	148	8.00	40.00	90.00	39.87	0	0	0.0	Null	cm
	Volatile suspended solids	3	3.20	5.60	6.00	4.93	0	0	0.0	Null	mg/L
	Water temperature (C)	71	1.67	19.00	30.56	18.39	0	0	0.0	Null	deg C
07020011-655	Inorganic nitrogen (nitrate and nitrite)	1	11.83	11.83	11.83	11.83	0	0	0.0	Null	mg/L
07020011-663	Ammonia-N	2	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	2	11.10	11.55	12.00	11.55	2	0	0.0	230.00	mg/L
	Dissolved oxygen	2	4.77	6.25	7.73	6.25	1	1	50.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	2.40	9.70	17.00	9.70	0	0	0.0	Null	mg/L
	pH	1	7.15	7.15	7.15	7.15	1	0	0.0	6.50	
										9.00	
	Specific conductance	2	596.00	656.50	717.00	656.50	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	2	0.13	0.17	0.21	0.17	0	0	0.0	Null	mg/L
	Total Phosphorus	2	0.16	0.19	0.23	0.19	0	2	100.0	0.15	mg/L
	Transparency, tube with disk	1	44.00	44.00	44.00	44.00	1	0	0.0	10.00	cm
	Water temperature (C)	2	18.26	21.15	24.04	21.15	0	0	0.0	Null	deg C
07020011-664	Ammonia-N	1	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Dissolved oxygen	2	12.02	12.46	12.90	12.46	2	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	5	5.30	11.74	21.00	12.57	0	0	0.0	Null	mg/L
	pH	2	8.14	8.25	8.35	8.25	2	0	0.0	6.50	
										9.00	
	Specific conductance	2	6.30	328.65	651.00	328.65	0	0	0.0	Null	uS/cm
	Total Phosphorus	3	0.03	0.07	0.55	0.22	2	1	33.3	0.15	mg/L
	Total suspended solids	3	3.20	18.00	340.00	120.40	2	1	33.3	65.00	mg/L
	Transparency, tube with disk	2	70.00	79.50	89.00	79.50	2	0	0.0	10.00	cm
	Volatile suspended solids	3	3.20	3.60	80.00	28.93	0	0	0.0	Null	mg/L
	Water temperature (C)	2	27.10	27.25	27.40	27.25	0	0	0.0	Null	deg C
07020011-665	Ammonia-N	7	0.00	0.00	0.00	0.00	0	0	0.0	Null	mg/L
	Chloride	4	12.90	16.75	20.40	16.70	4	0	0.0	230.00	mg/L
	Dissolved oxygen	22	7.22	7.78	9.26	7.88	22	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	10	0.36	8.30	13.00	6.44	0	0	0.0	Null	mg/L
	pH	8	7.40	8.20	8.39	8.05	8	0	0.0	6.50	
										9.00	
	Specific conductance	10	526.00	606.00	700.00	612.30	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	4	0.08	0.10	0.22	0.12	0	0	0.0	Null	mg/L
	Total Phosphorus	8	0.10	0.12	0.28	0.16	5	3	37.5	0.15	mg/L
	Total suspended solids	4	4.40	9.20	340.00	90.70	3	1	25.0	65.00	mg/L
	Transparency, tube with disk	30	11.00	38.00	100.00	54.20	30	0	0.0	10.00	cm
	Volatile suspended solids	4	1.60	3.40	47.00	13.85	0	0	0.0	Null	mg/L
	Water temperature (C)	22	17.01	20.45	25.83	21.21	0	0	0.0	Null	deg C
07020011-668	Ammonia-N	1	0.16	0.16	0.16	0.16	0	0	0.0	Null	mg/L
	Chloride	1	20.70	20.70	20.70	20.70	1	0	0.0	230.00	mg/L
	Dissolved oxygen	3	5.85	7.12	13.10	8.69	3	0	0.0	5.00	mg/L
	Inorganic nitrogen (nitrate and nitrite)	2	1.90	6.01	10.11	6.01	0	0	0.0	Null	mg/L
	Specific conductance	1	683.00	683.00	683.00	683.00	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	1	0.29	0.29	0.29	0.29	0	0	0.0	Null	mg/L
	Total Phosphorus	1	0.31	0.31	0.31	0.31	0	1	100.0	0.15	mg/L
	Transparency, tube with disk	2	60.00	60.00	60.00	60.00	2	0	0.0	10.00	cm
	Water temperature (C)	3	18.80	22.80	23.92	21.84	0	0	0.0	Null	deg C
07020011-669	Ammonia-N	11	0.00	0.00	0.19	0.02	0	0	0.0	Null	mg/L
	Chloride	10	8.51	12.30	15.10	12.06	10	0	0.0	230.00	mg/L
	Chlorophyll-a (corrected for periphyton)	16	0.00	0.01	0.04	0.01	16	0	0.0	0.04	mg/L
	Dissolved oxygen	53	3.46	7.70	11.24	7.92	49	4	7.5	5.00	mg/L
	E.coli	15	121.00	309.00	1,259.00	411.16	1	14	93.3	126.00	MPN/100mL
							15	0	0.0	1,260.00	MPN/100mL
	Inorganic nitrogen (nitrate and nitrite)	24	0.00	4.15	8.55	3.65	0	0	0.0	Null	mg/L
	pH	35	7.45	7.99	8.31	7.93	35	0	0.0	6.50	
						7.93	35	0	0.0	9.00	
	Specific conductance	37	302.00	557.00	1,217.00	556.79	0	0	0.0	Null	uS/cm
	Total Orthophosphorus	8	0.08	0.36	0.39	0.29	0	0	0.0	Null	mg/L
	Total Phosphorus	37	0.06	0.19	0.40	0.20	8	29	78.4	0.15	mg/L
	Total suspended solids	21	8.00	28.00	71.00	31.19	20	1	4.8	65.00	mg/L
	Transparency, tube with disk	289	4.00	14.00	80.00	16.00	210	79	27.3	10.00	cm
	Volatile suspended solids	11	2.40	5.60	13.00	6.80	0	0	0.0	Null	mg/L
	Water temperature (C)	53	4.52	22.56	27.30	21.05	0	0	0.0	Null	deg C

Appendix B. All IBI

Fish Use

FieldNum (Station)	Day of Visit Date	FIBI Threshold	FIBI
01MN014	7/11/01	33	**18.0**
01MN030	7/11/01	33	**27.7**
	7/23/08	33	**49.0**
	8/1/18	33	**47.2**
01MN039	7/11/01	50	**36.4**
01MN040	7/26/01	15	**45.5**
03MN067	7/8/03	50	**47.8**
03MN070	7/7/03	50	**47.2**
03MN071	7/28/03	49	**40.6**
	7/23/08	49	**34.4**
	9/4/19	49	**40.0**
07MN057	8/15/07	55	**53.6**
	6/25/08	55	**47.6**
07MN062	8/16/07	35	**34.2**
	7/31/18	35	**25.1**
07MN066	8/14/07	55	**48.1**
08MN001	8/7/08	49	**38.6**
	9/4/19	49	**59.0**
08MN002	7/29/08	35	**21.7**
	7/16/18	35	**22.5**
08MN003	7/30/08	49	**56.8**
	8/5/19	49	**55.6**
08MN004	7/23/08	50	**45.4**
	7/15/19	50	**46.4**
08MN005	7/8/08	49	**25.4**
	8/24/10	49	**38.8**
	8/6/18	49	**50.1**
08MN006	7/9/08	50	**30.3**
	8/7/19	50	**42.9**
08MN008	6/25/08	15	**15.6**
	7/31/18	15	**23.8**
08MN009	7/31/18	55	**36.7**
08MN010	6/23/08	55	**52.2**
08MN012	6/24/08	33	**40.2**
08MN013	6/24/08	33	**35.6**
08MN014	6/25/08	33	**10.8**
08MN015	6/26/08	33	**21.1**
08MN017	6/24/08	50	**32.7**
	8/8/18	50	**27.9**
08MN019	8/4/08	49	**51.4**
	8/20/08	49	**47.5**
08MN020	6/26/08	55	**38.5**
08MN022	6/25/08	33	**41.6**

Fish Use

FieldNum (Station)	Day of Visit Date	FIBI Threshold	FIBI
08MN022	8/1/18	33	**34.5**
08MN023	7/24/08	50	**41.7**
	8/6/19	50	**49.0**
08MN024	8/6/08	50	**53.3**
08MN025	7/2/08	33	**40.8**
	7/29/08	33	**48.8**
08MN026	7/2/08	55	**12.0**
	7/30/18	55	**63.2**
	7/31/19	55	**0.0**
08MN027	7/21/08	55	**46.2**
	8/8/18	55	**46.4**
08MN028	7/2/08	15	**10.2**
	8/12/08	15	**31.4**
08MN029	7/22/08	50	**38.8**
08MN030	7/22/08	33	**32.1**
	7/16/18	33	**51.4**
08MN032	7/24/08	50	**48.6**
	8/9/18	50	**61.9**
08MN033	7/2/08	33	**27.1**
08MN034	7/3/08	55	**24.5**
08MN035	8/5/08	49	**43.1**
08MN036	8/5/08	49	**49.2**
	8/25/08	49	**56.8**
08MN037	7/21/08	55	**47.5**
	8/2/18	55	**45.1**
08MN038	7/15/08	55	**47.0**
	7/18/18	55	**52.0**
08MN039	7/16/08	50	**30.3**
	8/6/19	50	**41.2**
08MN040	7/23/08	50	**18.9**
	8/7/18	50	**36.3**
08MN041	7/22/08	33	**40.4**
08MN042	7/2/08	55	**34.9**
08MN043	8/4/08	15	**5.6**
08MN044	6/24/08	33	**40.6**
08MN045	6/25/08	33	**40.1**
	8/12/08	33	**44.4**
08MN046	7/16/08	33	**0.0**
08MN048	7/29/08	50	**48.8**
	9/3/19	50	**39.3**
08MN049	7/3/08	55	**42.4**
08MN050	7/2/08	55	**49.6**
	7/30/18	55	**51.3**

Fish Use

FieldNum (Station)	Day of Visit Date	FIBI Threshold	FIBI
08MN051	6/30/08	55	32.8
	8/19/10	55	46.8
08MN052	7/22/08	50	47.2
08MN053	7/21/08	50	52.3
	8/11/10	50	51.3
	7/15/19	50	56.2
08MN054	7/3/08	55	28.6
08MN055	7/15/08	50	40.8
	8/19/10	50	51.6
	7/18/18	50	38.2
08MN059	7/1/08	55	22.7
	7/28/08	55	37.3
08MN060	7/16/08	33	39.7
08MN061	7/16/08	33	56.5
	8/12/08	33	48.6
08MN062	7/17/18	33	0.0
08MN063	8/7/18	15	44.9
08MN064	8/11/08	15	10.4
08MN065	7/14/08	50	57.6
08MN066	7/30/08	33	24.3
08MN067	7/10/08	50	38.9
08MN068	7/16/08	33	37.2
08MN069	6/25/08	33	47.2
08MN070	7/9/08	50	46.6
08MN071	7/15/08	50	39.5
	7/15/19	50	51.1
08MN072	7/16/08	50	36.5
08MN073	7/30/08	33	25.1
08MN075	6/25/08	33	25.5
08MN076	8/6/08	50	30.2
08MN077	7/14/08	33	37.1
08MN078	6/23/08	33	33.4
08MN079	7/15/08	33	22.9
08MN080	7/1/08	15	18.0
08MN081	7/15/08	55	27.2
	8/12/08	55	31.5
08MN082	8/19/08	50	46.2
08MN083	7/8/08	35	21.7
08MN086	7/30/08	50	47.2
08MN091	8/21/13	50	45.7
	8/5/15	50	46.1
	8/23/17	50	51.5
	8/6/19	50	49.3

Fish Use

FieldNum (Station)	Day of Visit Date	FIBI Threshold	FIBI
08MN091	8/4/21	50	62.0
10MN160	8/12/10	50	53.1
	9/1/10	50	53.6
10MN161	8/23/10	50	38.2
10MN162	8/24/10	50	47.6
18MN001	7/31/18	55	47.0
18MN002	7/17/18	55	52.9
18MN006	7/30/18	33	16.7
18MN007	7/18/18	42	34.3
18MN008	8/1/18	33	27.3
18MN009	8/1/18	33	34.1
18MN010	8/7/18	50	45.0
18MN011	8/8/19	50	61.4
20EM076	7/27/21	50	59.1
91MN102	7/14/08	33	23.8
91MN104	7/23/08	33	31.0

MIBI Use

FieldNum (Station)	Day of Visit Date	MIBI Threshold	MIBI
01MN004	9/13/01	41	**43.1**
	9/12/02	41	**6.6**
01MN014	9/10/01	22	**16.7**
01MN030	9/10/01	22	**21.1**
	8/7/18	22	**45.5**
01MN039	9/10/01	37	**53.2**
01MN040	9/10/01	30	**24.4**
03MN067	8/25/03	37	**35.9**
03MN070	8/25/03	37	**57.0**
03MN071	8/20/03	37	**42.2**
	8/21/08	37	**47.2**
	8/14/18	37	**43.4**
04MN005	9/9/04	37	**37.7**
07MN057	8/11/08	41	**35.3**
07MN062	8/12/08	24	**53.1**
	8/25/08	24	**19.2**
	8/8/18	24	**19.0**
08MN001	8/20/08	31	**43.2**
	8/6/18	31	**47.4**
08MN002	8/14/08	22	**1.4**
08MN003	8/20/08	37	**31.8**
	8/6/18	37	**53.0**
08MN004	8/22/08	41	**46.2**
	8/8/18	41	**52.0**
08MN005	8/26/08	37	**41.1**
	8/25/10	37	**37.6**
	8/7/18	37	**31.4**
08MN006	8/6/18	41	**47.4**
08MN008	8/13/08	22	**21.0**
	8/8/18	22	**36.7**
		22	**14.2**
08MN009	8/13/08	37	**36.3**
	8/8/18	37	**10.1**
08MN010	8/12/08	37	**22.6**
08MN012	8/12/08	22	**27.8**
08MN013	8/14/08	22	**21.1**
08MN014	8/12/08	22	**25.3**
08MN015	8/12/08	22	**19.3**
		22	**13.1**
08MN017	8/12/08	37	**25.0**
	8/7/18	37	**31.4**

MIBI Use

FieldNum (Station)	Day of Visit Date	MIBI Threshold	MIBI
08MN019	8/13/08	41	**47.8**
08MN020	8/14/08	37	**13.7**
08MN022	8/12/08	24	**22.6**
		24	**28.9**
	8/9/18	24	**19.1**
08MN023	8/14/08	41	**20.7**
	8/8/18	41	**31.8**
08MN026	8/21/08	43	**50.0**
	8/8/18	43	**49.8**
08MN027	8/13/08	43	**50.4**
	8/7/18	43	**58.0**
08MN028	8/13/08	30	**38.5**
08MN029	8/13/08	43	**51.3**
08MN030	8/14/08	22	**26.9**
	8/7/18	22	**36.9**
08MN032	8/27/08	37	**34.3**
	8/8/18	37	**25.7**
08MN033	8/20/08	22	**18.4**
08MN035	8/20/08	37	**44.1**
08MN036	8/20/08	31	**40.4**
08MN037	8/7/18	41	**42.4**
08MN038	8/12/08	41	**19.4**
	8/8/18	41	**32.1**
	8/14/18	41	**41.0**
08MN039	8/14/18	41	**60.6**
08MN040	8/7/18	41	**40.4**
08MN041	8/14/08	22	**31.4**
08MN042	8/21/08	43	**40.0**
08MN043	8/13/08	22	**18.1**
08MN044	8/11/08	24	**13.6**
08MN045	8/11/08	22	**36.7**
08MN046	8/21/08	24	**29.1**
08MN048	8/21/08	43	**52.3**
	8/14/18	43	**56.7**
08MN049	8/14/08	37	**29.8**
08MN050	8/14/08	43	**47.8**
	8/7/18	43	**57.4**
08MN051	8/13/08	37	**25.7**
	8/25/10	37	**21.5**
08MN052	8/13/08	43	**57.2**
		43	**56.7**

MIBI Use

FieldNum (Station)	Day of Visit Date	MIBI Threshold	MIBI
08MN053	8/13/08	37	**38.2**
	8/25/10	37	**47.2**
	8/7/18	37	**39.4**
08MN054	8/13/08	43	**50.4**
08MN055	8/13/08	37	**39.0**
	8/25/10	37	**21.5**
	8/6/18	37	**31.3**
08MN057	8/27/08	37	**10.0**
08MN059	8/20/08	43	**39.8**
08MN060	8/11/08	22	**28.5**
08MN061	8/14/08	22	**36.5**
08MN062	8/7/18	24	**28.3**
08MN063	8/7/18	22	**22.6**
08MN065	8/26/08	37	**38.7**
08MN066	8/25/08	22	**15.9**
08MN067	8/26/08	41	**29.1**
08MN068	8/12/08	22	**22.3**
08MN069	8/11/08	30	**24.5**
08MN071	8/7/18	41	**41.0**
08MN072	8/14/08	41	**20.2**
08MN075	8/13/08	22	**9.2**
08MN076	8/13/08	41	**38.3**
	8/5/20	41	**32.4**
08MN077	8/12/08	22	**17.9**
08MN078	8/11/08	22	**17.4**
08MN079	8/12/08	22	**28.1**
		22	**30.8**
08MN080	8/25/08	22	**14.7**
08MN081	8/12/08	41	**22.1**
08MN082	8/21/08	37	**33.4**
08MN083	8/21/08	30	**15.6**
08MN086	8/14/08	41	**30.9**
08MN091	8/22/08	41	**61.9**
	8/21/13	41	**43.0**
	8/25/15	41	**55.0**
	8/10/17	41	**62.3**
	8/8/18	41	**59.6**
	8/5/20	41	**74.5**
10MN160	8/25/10	41	**65.5**
10MN161	8/25/10	41	**42.7**
10MN162	8/25/10	37	**45.5**